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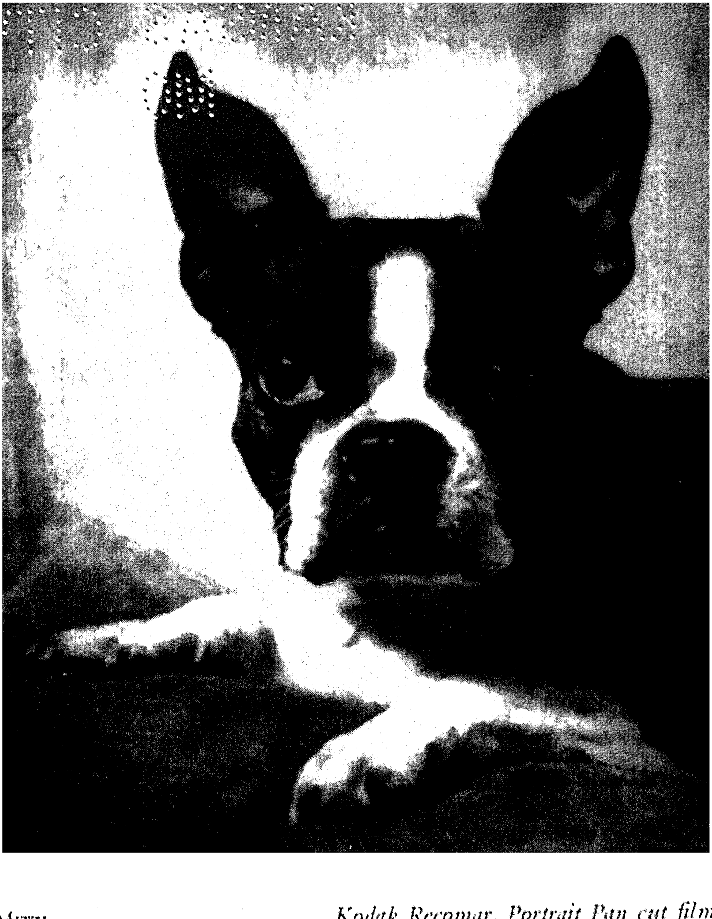
COMPLETE INTRODUCTION TO PHOTOGRAPHY



MITZI. *Kodak Recomar. Portrait Pan cut film. Flash at f:16. Paper negative. See Illustration 24 for original negative; Illustration 37 for process.*

COMPLETE INTRODUCTION TO PHOTOGRAPHY

By J. HARRIS GABLE, P.S.A.
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Illustrated

Drawings and Sketches by Allan Kennedy
Photographs by the Author, Claude Pilger, and others

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COMPLETE INTRODUCTION TO PHOTOGRAPHY

FIRST EDITION

I-P

To

Janice and J.

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PREFACE

Though this book is written primarily for the person just taking up photography, it is the author's hope that everyone interested in making better pictures may find it helpful. Nearly every type of photography and practically all phases of picturemaking, together with the operation of all types of amateur equipment, are discussed.

Assuming that the person just beginning his study of the subject should not be barraged with technical terms before learning their meaning, the material is arranged in logical order, with all the theory set forth and explained at the outset (Part I), before the discussion of the actual making of pictures (Part II). Matters pertaining to picturetaking, in turn, are discussed before processing and darkroom technique (Part III). The photos have been selected to illustrate the text, and are not intended to be examples of salon prints.

The author wishes to thank the Eastman Kodak Co., the Weston Electrical Instrument Corp., Claude Pilger (of the Lincoln Camera Club), Dwight Kirsch (of the University of Nebraska), H. A. Coleman, George Holmes, and Dr. Ralph Ireland for furnishing photographs; Claude Pilger and George W. Bucklin for advice and criticism on the manuscript; his many friends in the Eastman Kodak Store, and the Lawlor Sporting Goods Store in Lincoln, Nebraska, for assistance and advice; Mrs. Margaret Scott, G. Gordon Dewey and Beth Cornelison for assistance in preparation of the manuscript; and Allan Kennedy and Judson Miner for preparing the drawings and sketches.

Part I

THEORY OF PHOTOGRAPHY

Chapter I

PICTURES AND PICTURETAKERS

ANYTHING can be photographed that can be seen, whether by the naked eye or by the camera eye. The lens of the camera can actually "see" some things that we cannot, even with a microscope or with a telescope. It can see objects which move so rapidly that the human eye cannot discern any individual details of their motion, as, for example, a bullet leaving a gun or a hammer breaking a light bulb at the instant of impact. The fastest camera shutters can "stop" such motion so that it may be recorded on film. These are examples of some things which, without the help of the camera, would never be seen.

There are, however, many things that we *can* see with the unaided eye, and what we can see we can usually photograph. In this book we shall learn what photography is, and how to make pictures. We must know, for example, how cameras and lenses work, how film is used, how to take pictures of various sorts, and how to finish them properly. We must learn, not exactly what and how many kinds of pictures there are to be taken, but rather how the world of pictures at our disposal may be grouped and used.

What Is Photography?—Photography is both a science and an art. Perhaps it should preferably be spoken of as a "process." It is a process of forming an image of an object by the chemical action of light, and a photograph is a picture so made. The image is formed by the lens in the camera on light-sensitive material, the film, and developed and made permanent, or "fixed," by the photographer in

his darkroom. In the next few chapters we shall discover just how this chemical action works.

What Is a Picture?—Many photographers or camera users might call anything recorded by the camera a picture. I prefer to think of the products of clicking the camera as photographs, and to consider only the *good* photographs as true pictures. In this book, though, we will use the term "picture" to include all photographs, regardless of their quality or lack of it.

Anyone can click a camera, but not everyone can produce good pictures, because the production of good pictures depends upon a thorough knowledge of the subject of photography and also upon a knowledge and practice of darkroom work. The first may be referred to as photographic theory; the second as photographic technique. In this book we shall study both.

Classification of Pictures.—Besides classifying pictures as good or bad or in between, we may group them according to their subject matter, according to their type (that is, how they were taken), or according to their use. A good picture is one that can *make* you look at it and enjoy seeing it. A good picture possesses interesting subject matter in pleasing arrangement (composition).

Types of Photography.—All subjects for pictures are photographed, each by a particular method of picturetaking, and for a particular reason. Landscape pictures are usually taken for pictorial purposes; pictures of persons are usually taken as "record" shots; though sometimes the latter are of the "candid" type, which simply means that they were taken at close range and while the subjects were not looking. Candid ("open" or "frank") shots are unposed and usually taken with a miniature camera, because this type of camera generally has a fast lens.

Pictures of buildings usually fall into the pictorial class, and pictures of things are in the "still life" group. If the "things" should happen to be small statuettes or small figures, posed with suitable backgrounds and in interesting arrangements, the picturetaking work may fall into what is called "tabletop" photography.

Pictures of jewelry, furniture, clothing and foodstuffs, used for advertising purposes, fall into the class of commercial photography.

Two types of photography are yet to be mentioned: Pictures of persons, at rather close range, indoors, with suitable lighting, belong to portrait, or studio, photography. Finally, there are trick or freak pictures (trick photography). These pictures are as a rule made in the darkroom by special processes, though it sometimes happens that a double exposure, taken accidentally, may turn out to be a good freak.

Use for Pictures.—We may also classify pictures according to their uses. Many pictures are used for advertising purposes, because advertisers have found that readers will look at advertisements much more readily if they contain good pictures. Besides, most advertisers want to *show* their products to the public. Many photographers make good livings doing such work.

Others make pictures for newspapers, and this type of photography has become an art in itself.

Another great use for pictures is in illustrating stories, articles, textbooks, and catalogues.

Portrait work has always been of great importance. Even the dime stores have photographic departments where, for ten cents, one can get four poses in as many minutes. These pictures are taken directly on the paper itself, and do not use negatives. (See page 40.)

Many pictures are made simply because the photographer wishes to preserve a beautiful view, an attractive face, or a touching scene. An almost directly opposite use is in crime detection. Pictures have trapped many criminals by furnishing reproductions of scenes of crime that may be studied by detectives, by recording footprints, fingerprints, and other clues or evidence. The Federal Bureau of Investigation and most police departments make extensive use of photography.

Exhibitions and Salons.—Pictures are used for exhibition purposes, and such pictures must be good! Photographers want to make good pictures and want to see them "hung" in salons (exhibitions of good

pictures, held by camera clubs and associations, see Chapter XIX), or in exhibitions or "shows" held by camera clubs and other groups.

Exhibitions of prints are usually judged in classes, though salons use pictures on any subject side by side and have generally no divisions. In the latter case the excellence of the photography (both composition and finishing) is the basis for judging. Consequently, photographers must know how to make beautiful prints, and to this end several processes are described in Chapter XIX.

To make good pictures the photographer must recognize a picture when he sees it in the field; must have great patience, and should be a hard worker. Anything can be a subject for photography, but whether or not it becomes a picture depends upon the photographer, not upon the camera. There is no business or profession, no art or science, no sport, no branch of industry, that does not, or at least cannot, use photography in some way.

Chapter II

THE LENS

IF WE take the lens out of our camera and replace it by a cardboard with a small pinhole in the center we find that we can still take pictures but that the exposure will need to be long. If we use a larger hole in order to secure more light and reduce the exposure, the image will become blurred. So we need a lens, or a device for bending the light rays reflected from an object to be photographed, so that the light is joined again in a sharp image. Because a prism will bend a light ray as it enters the prism, and bend it still more when it leaves the glass, two prisms fastened together, base to base, will act as a sort of lens; therefore, glass lenses are shaped to bring about a similar bending of light rays.

FOCAL LENGTH

A lens forms a sharp image of an object in only one plane. When the lens is forming an image of the sun or any distant object (beyond 100 feet) this image is formed at a distance called the focal length of the lens (see Fig. 1).

For example, if we use a lens to focus an image of the sun on a cardboard, the distance the cardboard will be held from the lens is the focal length of that particular lens. If we use the lens to form an image on the cardboard of some closer object, the cardboard must be moved farther away. This process continues; the nearer the object the farther the cardboard is from the lens until it comes to a distance of twice the focal length of the lens. If the focal length of the lens

is 6 inches, the cardboard will be 6 inches back of the lens to form an image of the sun, but if it is forming an image of an object nearer than 100 feet it will have to be more than 6 inches from the lens; if the object is as close to the lens as 12 inches, the cardboard will have to be 12 inches back of the lens to bring the image to a focus. Twelve inches is twice the focal length of the lens of which we are speaking. If the object is closer, the image becomes larger (but not distinct) until the object comes to 6 inches, or one focal length, when the image virtually disappears.

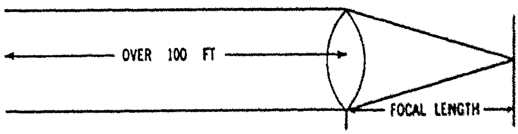


FIG. 1. FOCAL LENGTH OF LENS

An ordinary box camera cannot be used to take pictures at distances less than 4 or 5 feet, because such a camera is not built so that the lens can be placed a sufficient distance from the position where the image is formed to focus a near object sharply. This position is called the *focal plane.* The problem of focusing a camera is taken care of in several ways. For a box camera the focus is "fixed," which means that the camera is built so that the lens focuses on the nearest point which can still keep more distant objects fairly sharp.

Size of Image.—The image will be larger for lenses of long focal length than for lenses of short focal length, as is shown in Fig. 2, because the rays of light have a greater distance to spread or diverge before coming to a focus. It naturally follows that the lens of longer focal length, which spreads the rays of light farther apart before they reach the focal plane, makes a much larger image because the image of the object takes up more space on the film or on the ground glass in the focal plane. Also, since the image of the object is larger for the longer focal length lens, less background or other subject matter can be in the picture. With the lens of long focal

length the camera can be used farther from the object and still produce an image of the same size.

Light-admitting Quality.—Lenses differ from one another also in the amount of light they admit into the camera. As the amount of light admitted governs the length of the exposure, it is important to admit as much light through the lens as possible and still produce

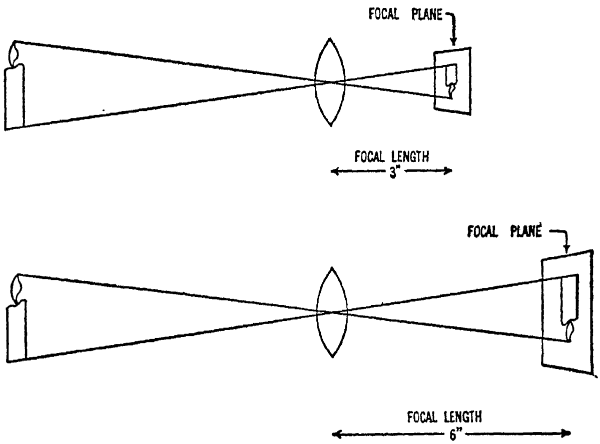


FIG. 2. FOCAL LENGTH GOVERNS SIZE OF IMAGE

a good image. The brighter the light the more quickly the image can be produced on the film, and the shorter the exposure will need to be. A lens that admits a great amount of light will require a shorter exposure than one that admits less light. So that larger lenses, or more light-admitting lenses, are valuable for taking snapshots in the dim light one would find in a motion-picture theater, for example, or, even in bright sunlight, for taking a short exposure of a rapidly moving object.

The amount of light admitted to the film is determined not by the diameter but by the area of the portion of the lens through which the light passes. A lens that has twice the diameter of another lens has 4 times the area and therefore admits 4 times as much light. The focal length of the lens must also be considered—because the amount

of space over which the light must be spread is important. A lens with a focal length of 6 inches must spread the light over a much larger area of film than a lens with a focal length of only 3 inches. A 2-inch diameter lens with a focal length of 6 inches will admit 4 times as much light as a lens with the same focal length but with a diameter of 1 inch, and the exposure need be only one-fourth as long. If the smaller lens has a focal length of only 3 inches it will admit as much light to its film as a lens of twice the diameter but with a focal length of 6 inches will admit to its larger film. The focal length, together with the size of the lens, thus governs the amount of light admitted to the film during the exposure.

THE FOCUS

Most scenes include objects at different distances from the lens and each of these objects will be in sharp focus at different distances behind the lens. If the focus is sharp for an object at a medium distance, objects nearer and objects farther will be more or less out of focus, depending upon how much nearer or how much farther they are from the principal object upon which the focus is made. The distance from the nearest object to the farthest object which can be reproduced in passably sharp focus (for a fixed position of the lens) is called the *depth of field.* For this same fixed position of the lens, the distance between the sharp-focusing positions of these near and far objects which are still in fair focus is called the *depth of focus.*

Near and Far Objects.—Figure 3 shows a near object and a far object and the positions at which they focus sharply. The dotted lines show where the rays of light from the far object come to a sharp focus and the solid lines show where the rays of light from the near object come to a sharp focus. Because we want some depth of field in our picture, that is, because we want to photograph some near and some far objects in the same picture, in addition to the principal object, we want to know what range of object field we can have. This diagram assumes that the lines marked near and far object are the nearest and farthest that we could use.

On the right side of the diagram, where the focuses for the near and far objects are shown, you will note the position of the best focus for both objects, which is neither the point where the one or the other focuses sharply but the point where the two lines cross. The solid lines, showing the paths of rays of light from the near object, that come together in a point at the focus for that object make a small disk of light instead of a sharp point at the position of the focus for the far object. Also, the dotted lines, showing the rays of light from the far object, which come to a sharp point at the focus for that object, continue in their paths and form a diffused disk of

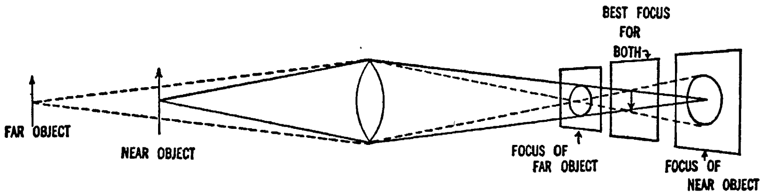


Fig. 3. Focus for Far and Near Objects, Showing Circles of Confusion

light, instead of a sharp point, at the position of the focus for the near object. These disks, greatly exaggerated in the figure, are called *circles of confusion*. The smaller we can make the circles of confusion the sharper our picture will appear to be, and the method of making these circles smaller involves the increasing of the depth of field and uses a device placed between the lens elements in the camera, called a diaphragm. (The diaphragm reduces the lens opening for pictures in bright light or increases it for dim light.)

DIAPHRAGM AND APERTURE

The diaphragm in most cameras is a metal screen made up of sections that turn upon one another in a circular motion, so as to make the opening in the center vary in size. This opening is called the aperture, and its size influences the action of the lens by varying the amount of light which passes through.

Stopping Down.—In Fig. 3 you will note that the rays of light from the near and far objects are passing through the entire lens. Figure 4 shows how the rays of light pass through the lens when the diaphragm is opened only part of the way. With the smaller opening the circles of confusion are much smaller; a greater depth of field and depth of focus can be had. This means that the pictures will be sharper and that more of the field of view will be in focus. On the other hand, there is much less light entering the camera, so that the exposure will have to be much longer than with the lens used at full aperture. This partial closing of the aperture is called "stopping down," and it is so called because the various

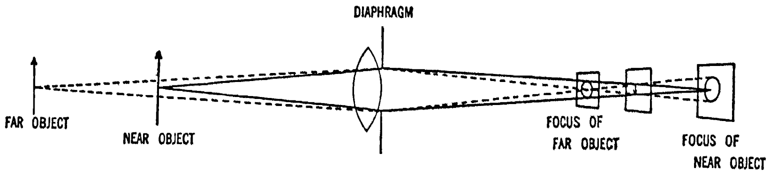


Fig. 4. Stopping Down Reduces Circles of Confusion

positions of the diaphragm are called "stops." The amount that the lens is "stopped down" really governs its "speed," as the stopping down permits less light to come through the lens and the lens consequently produces an image less bright.

As we usually want to take pictures that include objects both near and far from the camera, and as we want both near and far objects to be in fairly good focus, it naturally follows that we must use our lens stopped down part of the way. In fact, lenses with big apertures, that is, lenses large in diameter, can seldom be used at full aperture (wide open), but must be stopped down for most shots. Though the largest aperture cannot be used for ordinary shots, it sometimes comes in handy for shots that require extremely short exposure, such as for moving objects, where it is not necessary that the background be in sharp focus as well as the principal object.

F: Stops.—A lens mount has a scale of stops, together with a little lever that opens or closes the diaphragm. If the pointer is set

at f:8, this means that the diameter of the aperture is one-eighth of the focal length of the lens. If the focal length of the lens is called f., then one-eighth of its length might be called f/8, and this usually is written as f:8. Figure 5 shows a lens that is one-fourth of its focal length in diameter. Wide open, its speed is f:4. Stopped to half its diameter, its speed becomes f:8, because the diameter of the

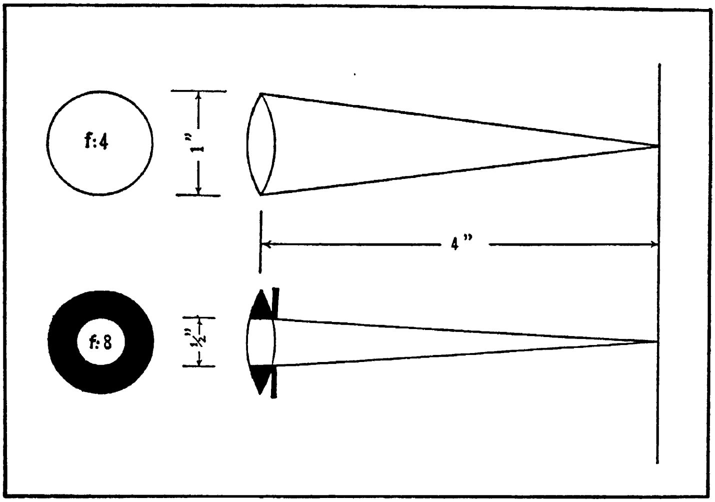


FIG. 5. F: STOP RATIOS

part of the lens which permits light to pass is one-eighth of the focal length of 4 inches. Since this opening is only one-fourth of the area of the largest aperture, its speed at f:8 is only one-fourth its speed at f:4. F:16 means that the diameter of the aperture is one-sixteenth of the focal length of the lens, and so on.

Lenses are rated according to size in proportion to focal length. A folding camera usually has an f:6.3 lens (about one-sixth of the focal length, or about 1 inch in diameter, if the focal length is 6 inches); the expensive "candid" cameras, such as the Leica or Contax, have lenses rated f:2, one-half of their focal lengths. As you

probably know, these lenses are large and of short focal length; in fact, most such lenses have focal lengths of 50 millimeters (about 2 inches), so that the f:2 lens is an inch in diameter. An f:2 lens with a focal length of 6 inches would have to be 3 inches in diameter, and would be very expensive. Consequently, in order to have a fast lens, it must be of short focal length. Figure 6 shows comparative sizes of lenses of the same focal length.

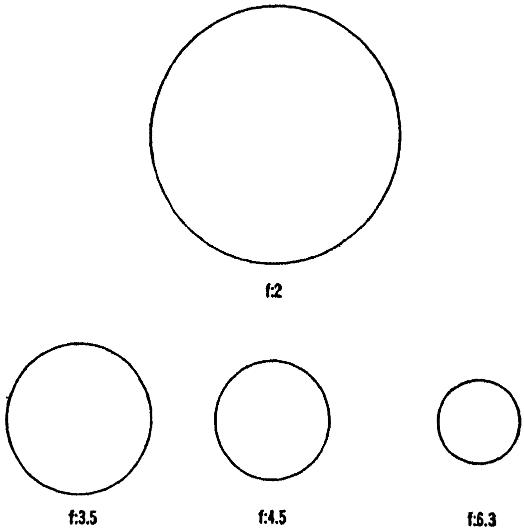


FIG. 6. COMPARATIVE SPEEDS OF LENSES

There are two systems used in marking stops: the f: system, and the Uniform System, usually called U.S. The U.S. numbers refer to the relative exposure required, while the f: system numbers refer to fractions of the focal length. The U.S. method indicates exposures required by various stops, beginning with a lens one-fourth its focal length in diameter. Here is the scale:

f.	f:4	f:4.5	f:5.6	f:6.3	f:8	f:11	f:16	f:22	f:32
U.S.	1	1.26	2	2.5	4	8	16	32	64

This means that, whatever the length of exposure is at f:4, at f:5.6

it will be 2 times as long, 4 times as long at f:8, 8 times as long at f:11, and so on.

TYPES OF LENSES

The simplest lens is a single piece of glass. A cross section of it is crescent shaped because this is the shape that produces the sharpest image in a fixed-focus camera. In such cameras the lens is fixed in the proper position for forming an image on the film. This lens is also called a *meniscus* (see Fig. 7). It does not have correction for color.

FIG. 7. MENISCUS LENS

Figure 8 shows that a simple lens does not bend rays of light of different colors the same amount, so that the blue rays come to a focus somewhat in front of the position where the red light rays focus. In order to correct this, two different lenses can be combined as shown in Fig. 9; since this combined lens includes the meniscus, it is called a *meniscus achromatic* lens.

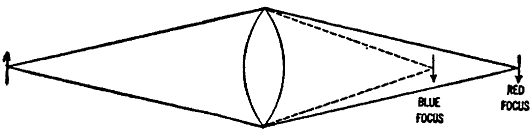


FIG. 8. FOCUS OF COLORS

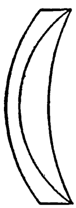


FIG. 9. ACHROMATIC LENS

Because the edges of this type of lens do not focus as well as the center of the lens, it can only be used stopped down, and this lens when stopped down produces a curvature of the edges of the picture. The edges will be curved either out or in as shown in Fig. 10 according to whether the stop is used in front of or behind the lens, but this may be corrected by using two such lenses with the stop between them. This type of lens is called a *rectilinear.*

There is a further correction necessary for a good lens. The

meniscus or rectilinear lens cannot form an image entirely flat, but rather produces it slightly in saucer shape with the edges of the picture not so sharp as the center, especially if the lens is used at large or full aperture. These lenses are therefore called *astigmatic*. Later lenses made from new kinds of optical glass, which can produce flat images, are called nonastigmatic or *anastigmatic* lenses,

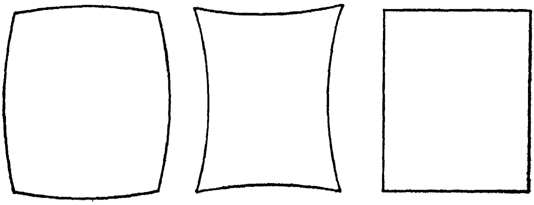


FIG. 10. THEORY OF RECTILINEAR LENS

usually referred to as "anastigmats." Some box cameras using the meniscus type of lens roll the film around a slight curve at the back of the camera (the focal plane) to overcome the tendency of the lens to produce saucer-shaped images.

Lenses, to include all the necessary corrections and to secure great "speed," become quite complicated, and are made up of several elements. Figure 11 shows specimen arrangements of the elements in lenses of various ratings, together with an indication of their relative speeds. (Not all lenses of these ratings are made according to the arrangements shown, of course.)

SUPPLEMENTARY LENSES

As we have said, lenses of long focal length make larger images of objects photographed, but take in smaller fields of view. There are special lenses made to slip on over the regular lens on the camera or, for other types of cameras, to replace the regular lens for the purpose of taking "close-up" shots of subjects from considerable distance. These lenses are called *telephoto* and are simply lenses with long focal length.

Then there are lens attachments or special lenses for taking pictures at close range. Where it is decided to include a great amount

of subject matter these lenses, or attachments, work in just the opposite way from the telephoto lenses: they reduce the focal length. Since they take in a greater field of view they are called "wide-angle" lenses. Because of the problem of focusing, these lenses can be used only on ground-glass focusing cameras or cameras with

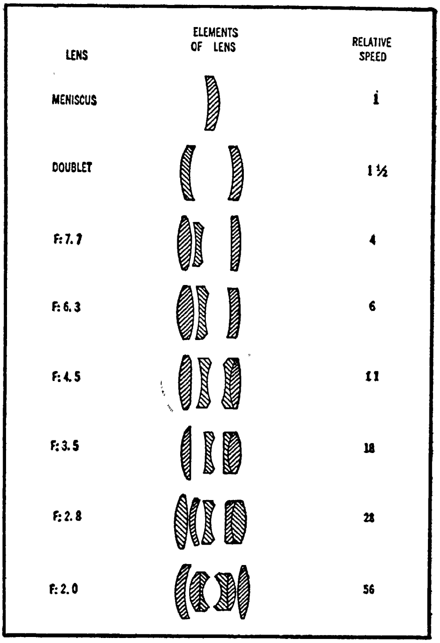


FIG. 11. LENS ELEMENTS AND RESPECTIVE SPEEDS

coupled range finders (see page 19), or by the use of specially adjusted finders.

Among other lens attachments is the diffusion disk, which slips over the regular lens and produces just enough diffusion of the light to soften the lines of a picture or portrait. There is also a special "portrait attachment," which slips over the lens, designed to produce a sharp image close up. These attachments are especially useful for the ordinary folding cameras which do not have sufficient bellows extension and ground-glass focusing arrangement for taking pictures at closer than 5 or 6 feet.

Chapter III

THE CAMERA

Let us suppose that we have chosen a subject to photograph. We already know what the lens will do for us, but there are some other things we need to know about the operation of the camera in order to secure a good picture. First is the matter of the focus.

THE FOCUS

All cameras except those with fixed-focus lenses have some device for moving the lens closer to or farther away from the focal plane and also some device whereby the photographer will know when the object he wishes to photograph is in focus. In some folding cameras the space between the lens and the focal plane consists of a movable bellows, and at the front end of the rack is a little scale marked in feet so that the lens may be placed to focus an image of an object at certain distances from the camera. In other (newer) types of folding cameras, and in most miniature cameras, the lens mount is in a fixed position, but the lens itself is in a threaded socket and may be screwed either out or in. The distance, in feet, for which it is in focus is indicated on the collar. This is called *helical focusing*, because the groove is in the long spiral shape called a helix. In either case, it is only necessary to know how far the object is from the camera. This distance may be stepped off, measured, or a range finder may be used.

The Range Finder.—This is a little instrument that may be kept in the pocket, or may be mounted on the camera, or is built into

some makes of cameras. To use the range finder one sights through a little window upon the subject to be photographed. In one type of range finder the image is split into upper and lower halves, and the one half may be either to the right or to the left of the other. By turning a little knob until the two halves are in correct position, the distance in feet may be read on a scale built into the device. Other range finders work on a slightly different principle, but there is always a gauge to give the actual distance to the object. The camera lens is then set for this distance, either by moving it along

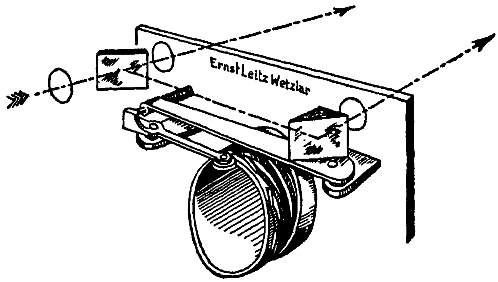


FIG. 12. COUPLED RANGE FINDER DIAGRAM

the rack or by turning the lens, depending upon the type of camera.

In expensive cameras the range finder is built into the camera and is coupled with the lens. In using a coupled range finder one sights through the little window as shown at left in Fig. 12, seeing two images. As the lens mount is rotated, the second image is brought to coincide with the first. The lens will then be in focus for the particular object sighted upon. The action of one type of coupled range finder is shown in the figure.

Ground-glass Focusing.—A third method of focusing is by use of a ground glass, for cameras so equipped. Ground glass, which is made from plain glass simply by grinding one surface with emery, is placed into the focal plane where the image is formed. The camera is then focused by watching the image appear on the ground glass as the lens is moved along its rack until the image appears sharp. If the camera is on a tripod, a small hand lens can be used to view

the image, and focusing by this method can be made even more sharp. When the camera is focused the ground glass is removed and cut film, film pack, or roll film is substituted for it and the picture may then be taken.

The reflex camera uses this method of focusing but in a little different way. Instead of the image being upside down as in the straight-view camera, the reflected image is formed right side up at the top of the camera by means of a mirror. (Refer to Fig. 17.) In this type of camera, when the reflected image is sharp the picture may be taken.

COMPUTING EXPOSURE

Now, whatever type of camera we are using, our camera is focused. We must next decide what aperture and what length of exposure to use. With a box camera the length of the so-called "instantaneous" exposure is fixed, but for any other type of camera, which can be set for different lengths of exposure, we must decide what exposure to give and set the shutter for that interval of time. To secure a good picture it is necessary that the exposure be correct.

As the shutter is the actual device used, in the camera, for making the exposure, and as we are not quite ready for our camera to click, let us first discover how long the exposure must be for the picture we want to take, how the shutter is set, and how it works.

Length of Exposure.—This depends partly upon the amount of light illuminating our subject, partly upon the amount the lens is stopped down, and partly on the speed of the film. So that we always speak of an exposure together with f: stop as: 1/25 sec. at f:16, 1/50 sec. at f:8, and so on. In the part of our book devoted to particular or special types of photography—for example, indoor work —we will learn the special exposure needs for each type. For general outdoor photography, however, there are some fairly good rules, and the exposure table on page 63 is a guide to the length of exposure and f: stops under different lighting conditions.

Though 1/25 sec. at f:16 has for many years been considered

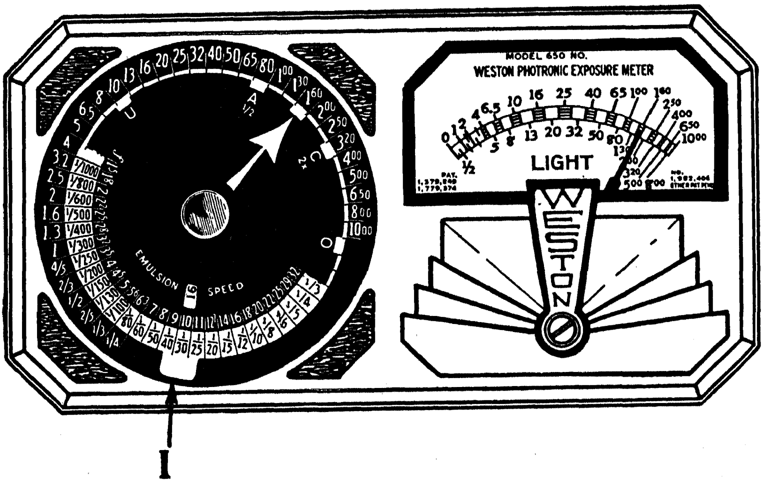
standard for snapshots, and is about what is used for most box, fixed-focus cameras, lighting conditions vary. The photographer wants to take pictures earlier or later in the day; he wants as many of his pictures as possible to be good pictures. So a number of devices, called *exposure meters*, have been invented to determine the proper length of exposure. Such meters can be used by all photographers whose cameras are equipped with diaphragms and shutters with several speeds.

Exposure Meters.—Such meters work according to the intensity of the light reflected by the subject or object to be photographed. One simple and inexpensive meter is the Leudi; another is the Instoscope. In using either of these the photographer sights through the instrument to find out which of a series of figures (in the Leudi) or a series of letters (in the Instoscope) is the faintest that can be distinguished readily. Of course, the brighter the object to be photographed the farther down the scale will be the faintest figure or letter still readable. When the instrument is set for the speed of the film (see below) and for the light value as read on the brightness scale, the user may then read on a scale of figures the length of the exposure necessary for the different f: stops. Since the figures or letters gradually grow darker until they cannot be read, this type of exposure meter is called the "extinction" type.

Some films are faster than others and, for the convenience of photographers, the relative speeds of different films have been given numbers in proportion. Unfortunately there are several systems, and though it is not necessary to know all about all these systems, we must know the rated speeds in order to use various meters which have to be set according to the film or emulsion speed. For example, to use either the Leudi or the Instoscope one must know the speed of the film according to the American Scheiner table; to use the Weston Electric Exposure Meter, which we will examine in a moment, one must know the Weston rating.

The electric meter, when held facing the object to be photographed, indicates automatically, by a needle moving across a dial,

the intensity of the light. Beside this dial is the calculating device; this is first set according to the emulsion speed and then set for the light value as read by the needle's position. Exposures for each f: stop may then be read on the scale. Figure 13 shows the light value to be 160, emulsion speed 16, set by lever I. The exposure at f:8, for example, is 1/50 sec.; at f:32, 1/3 sec. To set the instrument for the emulsion speed, the user must have at hand a list of the speed ratings; this list is furnished free by the manufacturers of the instrument.



Photograph Courtesy of Weston Electrical Instrument Corporation

FIG. 13. WESTON EXPOSURE METER

The meter shown in the figure is the Weston Meter, model 650 (a later model, called the Master, has two light intensity scales, one for use in weak light). The manufacturer of these instruments has drawn up a film speed rating system known as the Weston System. There are a number of other electrical type exposure meters, such as the Argus, General Electric, De Jur Amsco, Electrophot, Horvex, Photoscope, Photrix, and Tempiphot. These meters range in price from \$8.75 to \$26 and use either Weston or Scheiner speed ratings. They give aperture figures from about f:1.5 to f:32 or f:64,

and exposures from about 60 sec. to 1/1000 sec. The following table gives the (approximate) corresponding speed ratings for the Weston and American Scheiner systems:

Weston	Scheiner	Weston	Scheiner
1	6	20	19
2	9	24	20
2.5	10	32	21
3	11	40	22
4	12	50	23
5	13	64	24
6	14	80	25
8	15	100	26
10	16	125	27
12	17	160	28
16	18	200	29

THE SHUTTER

Setting the Shutter.—Let us suppose that we have discovered the length of the exposure and the f: stop by one of the methods just described. We are ready to set our aperture and shutter. Most cameras have what is called a "between-lens" shutter, so called because it operates between the units of the lens, where the diaphragm for stopping down also operates. Such shutters are made up of thin plates of metal sliding over one another in the same way as do the plates of the diaphragm. The diaphragm, however, makes a smaller or larger opening as it is moved by means of a lever (marked D in Fig. 14). The shutter, though acting in much the same way, is designed and built to open and close again slowly or quickly according to the tension put on the spring. Setting the exposure for different lengths of time puts the necessary tension on the spring or provides for the length of the exposure in other ways.

This setting may be made in several different ways, depending upon the make of camera being used. Some cameras have small levers with a pointer that can be set at different positions, but most cameras with between-lens shutters have knurled collars around the outside of the lens (see A, Fig. 14) that can be turned so that the figure for the length of exposure is brought opposite to a pointer

(E) on another (stationary) ring beside it. You will note that the speed is set at 1/25 sec. and the f: stop lever is set at f:11.

The shutter shown in the figure can operate at speeds from 1 sec. to 1/200 sec. and is a "compur" shutter, which means that settings between the times marked can also be made. For example, a speed of 1/75 sec. can be had by setting the collar so that the pointer is halfway between 1/50 and 1/100. The shutter also provides T and B exposures. T stands for "time," and when the shutter is set on T, one click of the trigger opens the shutter and the next click closes it. B means "bulb," and when the shutter is set for B, the trigger or cable release, when pressed, opens the shutter and holds it open until the finger is removed from the cable or trigger, when the shutter snaps shut again.

Focal Plane Shutter.—Some cameras have cloth or metal sheets or plates that act at the focal plane, in front of the film. These are called focal plane shutters and they also are moved by springs. The shutter curtain has in it a number of slits of different widths, or a single opening that can be varied in width, and the exposure is made by the slit passing before the film. This type of shutter can be made to operate as fast as 1/1000 sec. or even faster, though the between-lens shutter goes to only 1/500 sec.; between-lens shutters of this speed are found only on expensive cameras. The focal plane shutter also is used only on high-priced cameras.

The shutter in most box cameras is simply a hole or slot in a disk which rotates before the lens opening, moved by a spring and lever on the side of the camera.

Cocking the Shutter.—Now that the dials are set for shutter speed and f: stop we next cock the shutter. On most between-lens shutters there is a small lever which must be pushed a short distance to set the spring or cock the trigger. In Fig. 14 this cocking lever is marked F and is pushed in the direction shown by the arrow. On box cameras it is not necessary to cock the shutter. Many of the miniature cameras set the spring by turning a knob on top of the camera (which also rolls the film in a few makes of cameras).

Some between-lens shutters have "delayed action." By cocking the shutter, moving the little knob (G) back, and pushing cocking device on to the end of the slot, the shutter may be set so that when it is released it will not snap for about 15 seconds, thus giving the photographer time to get into the picture. Cameras without the

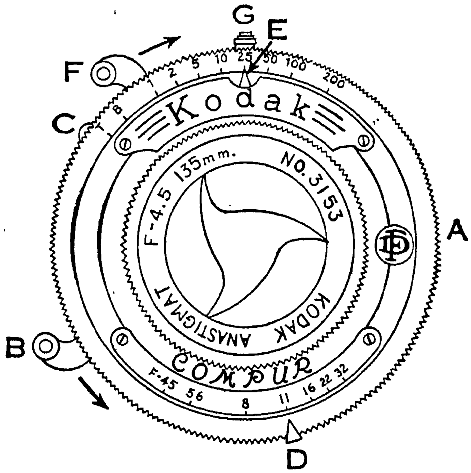


FIG. 14. THE SHUTTER

delayed action, but with cable releases, may still have delayed action, if desired, by means of a device on the cable release.

THE VIEW FINDER

Our camera is focused, the diaphragm is stopped down, the speed of the shutter is set, and the shutter is cocked. We next sight our object in the view finder; this brings us to an examination of the types of view finders in use.

The simplest type of finder consists of a little lens focusing a small image which is reflected either to the top or to the side in box cameras, used for horizontal pictures in one position and for vertical in the other. On some focusing cameras the two view finders are combined in one which may be turned so that the same finder may be used for either vertical or horizontal position of the camera.

This type of finder is shown in Fig. 15, which shows which part of the field is used for vertical (left) and horizontal (right) positions.

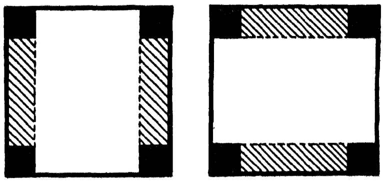


FIG. 15. VIEW FINDER

Direct-view Finder.—Many cameras do not now use the reflecting type of view finder because it must be used by holding the camera at the waist and sighting down into the finder. Since miniature cameras are used so much, the same type of view finder that they use is now being put on many other cameras as well. This is the direct-view finder, mounted on the side of the camera. It consists of two upright pieces of metal, one at the back with a small opening, and one at the front with a larger rectangular-shaped opening. When the camera is held up to the face so that the photographer can sight through both these upright arms, the view he sees outlined by the rectangular opening is the field that will be in the picture.

Some of these direct-view finders consist simply of the openings in the upright pieces, but many of them have lenses placed in the opening so that the photographer can see his field of view more distinctly and more definitely.

In many miniature cameras the view finder is built into the body of the camera instead of being on the side; some cameras combine the view finder with the range finder, that is, use the same little window to sight through for both purposes. In reflex cameras the view is composed and the camera is focused as the user looks into the top of it; for the ground-glass focusing cameras the view is composed and focusing is done by inspection of the image on the ground glass.

However the field of view is sighted, the view finder is used not

only to see to it that the subject to be photographed is actually in the field of view but also to compose the picture. Since the actual picture is shown in the view finder, you can so arrange the background, distance from the subject, and objects within the scene to obtain a pleasing picture. We shall have more to say about composition later on. (See Chapter VII.)

MAKING THE EXPOSURE

Now, with our camera all set to take the picture, and our view composed, we are ready to make the actual exposure. For box cameras the exposure is made simply by clicking the shutter, by moving the exposure lever either up or down, or simply by moving it if it is the kind that springs back into place. For most between-lens shutters the exposure is made by tripping a little lever, a sort of trigger, at the side of the lens mount (see B in Fig. 14). This releases the spring which opens and closes the shutter, and the shutter must again be cocked before another exposure can be made. Some folding cameras and most of the miniature cameras have the shutter release trigger in a more convenient position: at the top of the camera itself, or wherever it can most easily be reached by a finger, while the camera is held in normal picturetaking position, with the least possible jar to the camera itself.

Cable Release.—For between-lens shutters, and further to eliminate danger of moving the camera, there is an auxiliary device, known as a cable release, that may be attached. The cable release consists simply of a flexible wire in a tube screwed into the shutter (at position C in Fig. 14). When the disk at the end of the tube is pressed, the wire inside the tube enters the shutter and releases the spring. Many cameras come equipped with short cable releases, 5 to 7 inches in length, though it is possible to buy much longer cables, especially valuable for portrait work, and it is even possible to use a cable many yards in length for making pictures of wildlife. Older type view cameras, or studio cameras, use a bulb release—simply a long tube with a bulb on the end of it. When the bulb is pressed, air pressure releases the shutter.

The various things that must be done in order to take a picture with a camera have been discussed above. Before we turn to the taking of special kinds of pictures, such as night, indoor, children, still life, portraits, etc., let us find out, in the next two chapters, something about the various kinds of cameras and films being made, so that we may know which kinds are best adapted for different types of picturetaking.

Chapter IV

TYPES OF CAMERAS

THE simplest type of camera that we could have would be what is called a pinhole camera. The pinhole camera consists of a box with a pinhole in the center of one side, with the film on the opposite

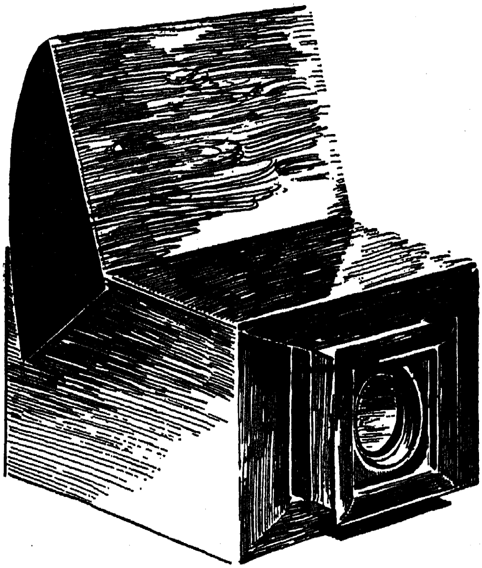


FIG. 16. CAMERA OBSCURA

side. Good pictures can be made with the pinhole acting in place of a lens, though the exposure must be quite long. This was the earliest type of camera used for making pictures on film. The camera obscura was a box with a lens (or pinhole) at one end and a ground glass at the other, much like a view camera of today (see Fig. 16).

This camera was used by artists. When directed toward an object it would make the image of the object on the ground glass, just as ground-glass focusing cameras do now. The artist could then draw his picture from the image on the ground glass of his camera obscura.

With the development of light-sensitive materials, photography came into general use, and we should know the kinds and uses of our modern cameras so that we may better understand the problems of picturetaking.

Cameras in use today may be classified as follows:

1. Box
2. Folding or Collapsible
3. View
4. Reflex
5. Miniature
6. Movie
7. Stereo
8. Color (one-shot)
9. Aerial

1. BOX CAMERAS

These have only a single lens (usually meniscus), with aperture about f:16, though some now have double lenses of larger aperture.

The shutter is usually a disk with a slot or hole which passes in front of the lens. The speed is about 1/25 sec. Some boxes are equipped for time exposure, by means of a sliding lever that pulls out at the top or side of the camera and causes the disk to stop so that the hole in it is over the lens.

Some boxes have one or more extra stops—round holes of various sizes in a sliding bar that moves before the lens to bring the holes of different sizes before the opening. The slide pushed all the way in places the largest hole in front of the lens; this hole is the largest stop opening, used for all ordinary snapshots. The slide pulled out to the next position brings a smaller hole in front of the lens, and

this should be used for bright conditions, such as bright sunlight, water, and snow scenes. The lens is placed so that objects 8 or 10 feet from the camera and beyond are in passably sharp focus. Some new box cameras have a supplementary lens which may be moved from its position in front of the opening by means of a little lever on a spring. When the lever is held so that this lens is pushed aside from the lens opening, the camera may be used for objects as close as 5 feet.

The view finder consists of a small lens and mirror to reflect the image to the little viewing glass at the top or side of the camera. Box cameras usually have two such finders, one for the vertical and one for the horizontal position. The direct-view finder is used on some box cameras. Cameras of this type include:

Name	Film	Number of Exposures	Picture Size	Exposure Range
Baby Brownie	127	8	1⅝ x 2½	I (snapshot)
Brownie Six-16	616	8	2½ x 4¼	I & T (time)
Brownie Six-20	620	8	2¼ x 3¼	I & T
Brownie Spec. 616	616	8	2½ x 4¼	I & T
Brownie Spec. 620	620	8	2¼ x 3¼	I & T
*Bullet	127	8	1⅝ x 2½	I & B (bulb)
Cadet B-2	120	8	2¼ x 3¼	I & T
Cadet D-6	116	8	2½ x 4¼	I & T
*Clipper	616	15	2½ x 2$\frac{1}{16}$	I & B
Univex A	00	6	1⅛ x 1½	I

* Collapsible.

(For directory of box and all other types of cameras, see annual directory of *Popular Photography* magazine, usually May issue.)

2. FOLDING, OR COLLAPSIBLE, CAMERAS

Most folding cameras are focusing. That is, the lens is placed at the end of a bellows, and may be either moved along the bed of the camera or turned in its threaded socket so that objects at varying distances can be brought into focus. In some (usually older) models the lens mount slides along the bed, called the rack, or may be moved along the rack by turning a knob at the side, and a pointer

on the lens board indicates on a scale the distance, in feet, for which the camera is focused.

Other models have the lens snap out into position when the front of the camera is opened, and these models are either fixed focus or they focus by revolving the lens mount. Cameras of this type include:

Name	Film	Number of Exposures	Picture Size	Lenses Available	Exposure Range
Baldaxette II	120	12	2¼ x 2¼	2.9; 2.8	1–1/400 T B
Baldax Square	120	12	2¼ x 2¼	2.9	1–1/250 T B
Foth Derby	127	16	1¼ x 1⅝	3.5; 2.5	1/25–1/200 B
Foth Derby, Super	127	16	1¼ x 1⅝	3.5	1/25–1/200 B
Garant	120	16	1⅝ x 2¼	4.5; 3.8	1–1/400 T B
Ikonta A	120	16	1⅝ x 2¼	3.5	1–1/500 B
Ikonta B	120	12	2¼ x 2¼	4.5; 3.5	1–1/300 B
Ikonta A, Super	120	16	1⅝ x 2¼	3.5	1–1/500 B
Ikonta B, Super	120	12	2¼ x 2¼	2.8	1–1/400 T B
Ikonta C, Super	120	8	2¼ x 3¼	3.5	1–1/400 T B
Kodak Duo Six-20	620	16	1⅝ x 2¼	3.5	1–1/500 T B
Kodak Jr. Six-16 (Series III)	616	8	2½ x 4¼	4.5; 6.3; 8.8	1/25–1/150 T B
Kodak Jr. Six-20 (Series III)	620	8	2¼ x 3¼	4.5; 6.3; 8.8	1/25–1/150 T B
Kodak Sr. Six-16	616	8	2½ x 4¼	4.5; 6.3; 7.7	1/10–1/200 T B
Kodak Sr. Six-20	620	8	2¼ x 3¼	4.5; 6.3; 7.7	1/10–1/200 T B
Kodak Spec. 616	616	8	2½ x 4¼	4.5	1–1/400 T B
Kodak Spec. 620	620	8	2¼ x 3¼	4.5	1–1/400 T B
Nettar A	120	16	1⅝ x 2¼	4.5	1–1/175 B
Nettar C	120	8	2¼ x 3¼	6.3	1/25–1/125 T B
Weltax	120	12	2¼ x 2¼	2.8	1–1/400 T B
Weltur	120	12	2¼ x 2¼	2.8	1–1/400 T B

3. VIEW CAMERAS

Some folding cameras are called "view cameras" because they use a ground glass at the focal plane for the purpose of focusing. These cameras usually have a sliding lens mounted on a bellows,

with indicator and distance scale, but may also be focused by viewing the image (inverted) on the ground glass. After focusing, the ground glass is slipped out of the camera and replaced by holders carrying cut film, glass plates, film packs, or even roll film in special adapters. Such cameras have provision for extending the bellows to some distance beyond the focal length of the lens, so that objects may be photographed at close range, even as close as twice the focal length, in which case the focal plane must be at a distance of twice the focal length from the lens. Cameras of this type are used for studio (portrait and commercial) work and for technical photography. They include:

Name	Picture Size	Available Lenses	Exposure Range
Bee Bee A	2½ x 3½	3; 4.5; 3.5	1–1/250 T B
B	3½ x 4¾	3.5; 4.5	1–1/200 T B
Ideal B	3½ x 4¾	4.5	1–1/200 T B
Kodak Recomar 18	2¼ x 3¼	4.5	1–1/250 T B
33	3½ x 4¾	4.5	1–1/200 T B
Linhof	2¼ x 3¼; 3½ x 4¾; 4 x 6	4.5; 3.5	1–1/200 T B
Maximar A	2½ x 3½	4.5	1–1/400 T B
B	3½ x 4¾	4.5	1–1/200 T B
Speed Graphic	2¼ x 3¼; 3¼ x 4¼; 4 x 5; 5 x 7	4.5	1/10–1/1000 T

4. REFLEX CAMERAS

Reflex cameras are so called because they contain mirrors to reflect the image of the object to be photographed onto a ground glass; this focusing screen is usually at the top of the camera. Figure 17 shows the action of a typical reflecting camera. The object or scene to be photographed may be focused by sighting into the top of the camera. When the exposure is made the mirror snaps up out of the way. In the cheaper cameras of this type the mirror pulls the shutter with it, but the better cameras use focal plane shutters (see page 24). Reflecting cameras include:

Name	Film	Number of Exposures	Picture Size	Lenses Available	Exposure Range
*Graflex, Auto			3¼ x 4¼; 4 x 5		1/5–1/1000 T
Graflex, B			2¼ x 3¼; 3¼ x 4¼; 4 x 5; 5 x 7		1/5–1/1000 T
Graflex, D			3¼ x 4¼; 4 x 5		1/5–1/1000 T
Ikoflex III	120	12	2¼ x 2¼	2.8	1–1/400 B
National Graflex	120	10	2¼ x 2½	3.5	1/30–1/500 B
Pilot 6	120	12	2¼ x 2¼	6.3; 4.5	1/20–1/150 T B
Primarflex	120	12	2¼ x 2¼	3.5	1–1/1000 T B
Rolleicord	120	12	2¼ x 2¼	4.5; 3.5	1–1/300 T B
Rolleiflex 6 x 6	120	12	2¼ x 2¼	3.5	1–1/500 B
Rolleiflex 4 x 4	127	12	1⅝ x 1⅝	2.8	1–1/500 T B
Voigtlander	120	12	2¼ x 2¼	3.5	1–1/300 T B
Voigtlander Brilliant	120	12	2¼ x 2¼	4.5; 3.5	1–1/500 T B

* Graflex cameras use cut film, plates, film packs, or roll film.

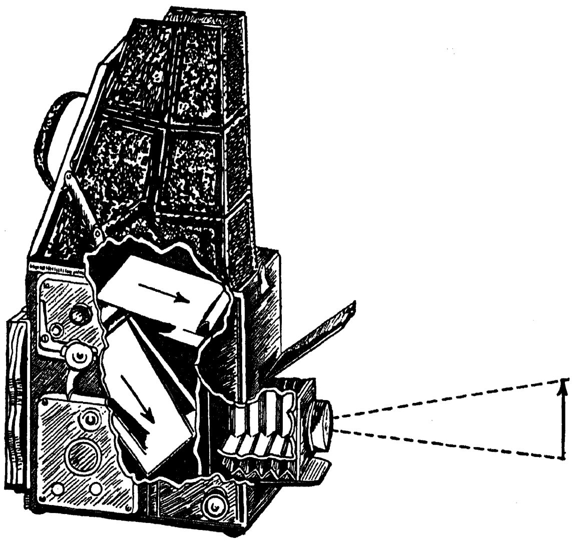


FIG. 17. ACTION OF REFLEX CAMERA

5. MINIATURE CAMERAS

Miniature cameras are so called simply because they take pictures of small size. Some photographers consider as "miniature" any camera making negatives up to 2¼ by 3¼ inches, though some consider only the cameras using the 35 mm. film as true miniature cameras. In our directory of cameras of this type only the 35 mm. size are included. The particular use of miniature cameras is for "candid" shots, or unposed pictures taken from life. The miniature camera is usually built especially for this type of work, and has a rather large lens of short focal length (f:2, 50 mm.), so that a short exposure can be made in fairly poor light. Most miniature cameras are of the collapsible type, and many are folding, self-erecting cameras. The better miniature cameras use lenses that can quickly and easily be replaced by other lenses of longer focal length or for special purposes, and such cameras are equipped with good coupled range finders and accurate view finders. Some have attachments for rapid winding. This type of camera includes:

Name	Lenses	Exposure Range
Argus A_2	4.5	1/25–1/200 T B
Argus A_2F	4.5	1/25–1/200 T B
Argus C2	3.5	1/5–1/300 B
Baldina, Super	2; 2.8; 2.9	1–1/500 T B
Candid Midget	2.9; 3.5; 4.5	1/25–1/300
Contax	1.5; 2; 2.8; 3.5	1/2–1/1250 B
Dollina	2; 2.8; 2.9; 4.5	1–1/500 T B
*Exakta	2; 2.8; 3.5	12–1/1000 T B
Kodak Bantam Spec.	2	1–1/500 T B
Kodak Retina	2; 2.8; 3.5	1–1/500 T B
Kodak 35	3.5; 4.5; 5.6	1/10–1/200 T B
Leica	1.5; 2; 3.5	1–1/1000 T B
Nettax	2.8	1/5–1/1000 B
Robot	2.8; 3.5	1–1/500 B
Welti	2; 2.8	1–1/500 B
Weltini	2; 2.8	1–1/500 B

* A reflex camera.

6. MOVIE CAMERAS

These are cameras built for taking motion pictures. They use rolls of 50 or 100 feet of film, which is made in several widths: 8 mm., 16 mm., and 35 mm. Some motion-picture cameras are fixed focus; some variable focus. They uses lenses ranging up to f:1.5 with extremely short focal length. They are operated by spring motors, and have a shutter taking 16 pictures to the second at normal exposure of 1/30 sec. (see Chapter XII).

7. STEREO CAMERAS

These cameras are built to take two pictures at once, using two lenses set at the distance apart that an adult person's eyes are spaced, though some have special lenses including prisms to divide the picture into two parts. The stereoscope is a device through which one looks at stereo, or double, pictures which, by use of a lens before each eye, appear as one, but with depth or third dimension (see page 126).

8. COLOR CAMERAS

These cameras are built for taking pictures in natural color, and are described in Chapter XVIII.

9. AERIAL CAMERAS

Any type of camera can be used to take pictures from the air. The chief requirement is that the camera be fastened securely, but with shock absorbers, if possible, to withstand the buffeting of the air. The true aerial camera is used for *aerial mapping*, and this type, usually built into the bottom of a plane, generally has 5 or more lenses, to take pictures in different directions simultaneously.

CHOOSING A CAMERA

If you have never operated a camera it would be wise to buy an inexpensive box camera to use until you learn the subject of photography. When you need a camera that will do more things than you

can accomplish with the ordinary box camera with simple lens, give some thought to the type of camera to buy. Decide what type of pictures you especially want to take and buy a camera for that purpose; or decide what types of pictures you do not care to take and eliminate from your consideration cameras specially equipped for taking them. Cameras with special equipment often cost a great amount of money, though there are good standard cameras that can have special equipment added to them or fitted to them, or that have many accessories built to be interchangeable.

Do not be careless in making the selection or you may become so dissatisfied with your purchase that you will give up photography as a hobby, or else will have to spend extra money to buy the equipment you should have purchased in the first place. Also, a camera need not be purchased as one buys an automobile, with the idea that it will be either worn out or out of style in a few years. A well-built camera can last a lifetime, if given good care and with no accidents. In general, no beginner should buy an expensive miniature camera. It is best to purchase a cheaper model to use, until sure that you want to continue this type of photography.

Probably the best rule to follow in selecting a camera is to have in mind how much you want to spend, what type of work you want to do, and the cost of upkeep for the camera, film, and other materials necessary to photography.

Chapter V

FILM

OUR modern cameras use film either in separate pieces for each exposure (cut film or film packs—12 pieces of film made up into a pack; see page 56) or film in rolls.

Film consists of a transparent base on which has been coated a "solution" sensitive to light and called the emulsion. Film, as we know it today, is not old. Before flexible, lightweight film was invented photographers had to use glass plates with the light-sensitive emulsion coated on them; before the glass plates were developed, sheets of metal were used. Glass plates, in fact, are used by some photographers, and for some purposes, even today.

THE STORY OF FILM

In the year 1732 J. H. Schulze recorded his discovery that a chemical compound called silver chloride was darkened by light. About five years later another man, in Paris, discovered that if writing was done on paper with a compound called silver nitrate the writing could not be seen until it had been exposed to light.

A silhouette is a picture of the outline of a person's head made in profile and filled in with one color, usually black. Years ago silhouettes were made by tracing the outline of a shadow on a sheet of paper and then cutting it out to use as a pattern for making a black image. About 1802 two men, T. Wedgwood and Humphry Davy, made profiles in this way, but instead of using a piece of plain paper on which to cast the shadow they used paper treated with

silver nitrate, because the chemical was turned black by the light and the shadow was left unchanged. Wedgwood thought he could use paper treated with silver nitrate in a camera obscura in place of the ground glass and thus make a picture. But he found that his paper was not sensitive enough to obtain the action he desired.

Davy made the same experiments, using silver chloride instead of silver nitrate, and did secure some pictures. His pictures are probably the first ever made by a lens on a sensitized paper.

Though Davy was thus able to make pictures, there was no way to make them last. The part of the picture that had not been acted upon by light gradually darkened as the picture was exposed to the light, so that something was needed to remove the silver chloride that had not been darkened by light when the original exposure was made. Not until 1839 was it discovered that a certain chemical ("hypo") could dissolve out the unchanged silver chloride. This process of removing the unchanged chemical by simply dissolving it away from the chemical that had been darkened by the light was called "fixing," and it is used in about the same way today.

Naturally, other persons began to experiment with light-sensitive materials. One of these experimenters was Jacques Daguerre. He took plates of silver and fumed them with iodine, which changed the surface of the plate into a thin film of silver iodide. When these plates were exposed in the camera, with a long exposure, they showed a faint image. Daguerre was for a long time unable to make the image stronger. One memorable day he left a number of his exposed plates in a closet where he usually kept his chemicals. The next morning, instead of a faint image, he found a good strong positive image on the top plate. He thought that one of the chemicals kept in the closet had caused this image to appear, but he did not know which one. So he removed one chemical from the closet each day, attempting by elimination to discover the active chemical, until he had all the chemicals out of the closet. But the image continued to appear overnight! Then he discovered that some mercury had been spilled on the floor, and that the mercury vapor which

deposited on his plates was making a positive image. Daguerre's process quickly came into general use and was used for many years.

In 1841 Fox Talbot used a paper, instead of a metal plate as Daguerre had done, and coated it with silver iodide. After taking a picture on it he washed his paper with a solution containing silver nitrate which, he found, would deposit silver where the light had acted, thus building up the original faint image into a picture. This building up of an image on the plate, or on our modern film, is called "development," and is discussed in Chapter XIII.

The Negative.—Fox Talbot was thus the first person to develop a strong image on paper, without using such a substance as mercury. But since the light entering the camera comes much stronger from the light parts of the subject being photographed, the film will be acted on more heavily in these areas and less heavily in the areas reproducing the darker parts of the subject, so that the image on the film is dark where the subject was light and light where the subject was dark. Light sky, for example, shows in the film as being dark and dark shadows are shown as being light. Since this complete reversing of the light is true, we call the film image a "negative." From the negative we must make a print which reverses the process. Talbot discovered that if he exposed his paper for a shorter time he could develop it into a negative image. Therefore, he was the first person to develop an invisible image and also the first person to print a positive image from such a negative.

In order to "print" from a negative onto another sensitized sheet of paper Talbot had to arrange for light to pass through his negative so that the patches that were dark would not register so heavily on the other paper, and so that the patches of his negative that were light would permit the light to shine through much more strongly, and therefore register much darker, thus forming the positive. He had to coat his paper bearing the negative image with oil to make it more transparent, and the early roll films had the chemicals coated on an oil-treated paper.

Later Developments.—The next process was called the "wet-plate" process. The photographer using this process had to make his own plates just before using them, by coating a clean piece of

glass with his chemical solution. The photographer in the field had to carry a portable darkroom, usually some sort of tent, and photography was difficult (see Fig. 18).

The chemicals on these wet plates were made sensitive to light by putting the plates, containing a soluble iodide in the emulsion, into a bath of silver nitrate, which formed silver iodide in the layer of dissolved chemicals. The plate was exposed while still wet, and immediately after the exposure was made it had to be developed.

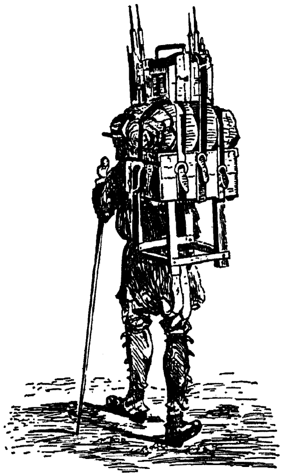


Fig. 18. Photographer of the 1880's

Redrawn from reproduction in *The Fundamentals of Photography*, by C. E. K. Mees, Eastman Kodak Co.

The next process was the one still used, the gelatin emulsion, in which the sensitive chemicals are held in a thin sheet of gelatin. An emulsion is a mixture in which another substance can be held in what is called "suspension" without dissolving. In the photographic emulsion the silver is held in such suspension.

Gelatin emulsions were first made by a Dr. Maddox in 1871, and the manufacturers of emulsions sold them in dried form. The photographer had to melt them in hot water in order to coat his glass plates. The plates, however, did not have to be used wet, as did the plates in the wet-plate process, so the new process was called "dry-plate" process. Later the manufacturers sold pieces of glass already coated and dried.

It was George Eastman who had the idea for a lighter support for the emulsion because glass was both breakable and heavy.

HOW FILM IS MADE

The film base, called the "support," is made from cotton which has been treated with a mixture of two acids, sulphuric and nitric.

The cotton so prepared is treated with other chemicals and camphor and formed into a thin sheet, on which the emulsion is coated. This film base (called "nitrocellulose") is inflammable. Another method of making film base uses acetic acid instead of nitric, and this makes a film base called "cellulose acetate" which does not burn readily. This type of film is called "safety base" film, and is used chiefly for amateur motion-picture work.

The emulsion is made of three things: (1) gelatin; (2) silver nitrate; and (3) potassium bromide. The gelatin is made from ani-

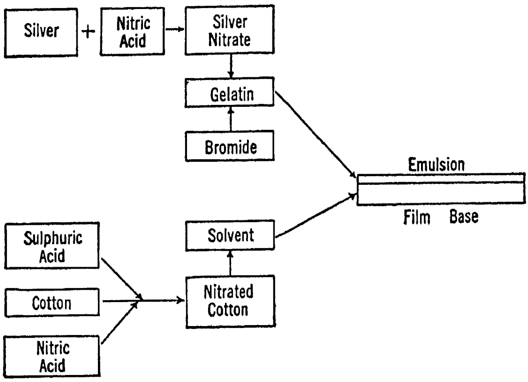


FIG. 19. INGREDIENTS IN MAKING FILM

mal tissues, usually the skins. The silver nitrate is made simply by dissolving silver in nitric acid (see Fig. 19).

The gelatin is soaked in water until it dissolves, then the potassium bromide is added to the solution and dissolved. The silver nitrate is added last and joins with the potassium bromide in the emulsion to make silver bromide—the material that is sensitive to light. Of course, from the time the silver nitrate is added until the film is used and developed it must be kept in darkness. The emulsion is then coated on the film base. Some emulsions contain a small amount of silver iodide. Some are more sensitive to light than others, and the amount of sensitiveness depends upon the amount of heat used in making them and the length of time they are heat treated.

The more heat (and sometimes treatment with ammonia) the more sensitiveness. The more sensitive films are referrd to as "faster" films, and have a much higher Weston rating.

The emulsion contains many millions of tiny crystals of silver bromide, which are sensitive to light. When the film is exposed in the camera these crystals are affected by the light in a peculiar way. The developer then separates the bromide and leaves the little grains of pure silver which make up the image. This action is described in Chapter XIII. The stronger the light that shines upon the subject, and therefore enters the lens of the camera, the more grains of silver bromide are affected and the darker will be the deposit of silver on the negative.

In order to prevent film from curling too much, a layer of gelatin is put on the back as well as on the front. On most films this back coating is also treated by a dye which controls a tendency toward fuzziness or spreading of the light around bright objects. This spreading of light is called "halation," and film so treated is called "antihalation," or nonhalation, film.

TYPES OF FILM

The ordinary film, such as regular Kodak NC film or Agfa's regular, has a fair speed for snapshot work. Like most films made today for general photographic work, it has a considerable "latitude," which means that the exposure can be somewhat too short or somewhat too long without losing the picture.

Orthochromatic.—The plain emulsion on a film is highly sensitive to blue light, but is less sensitive to light of other colors. Film is made more sensitive to colors by placing certain dyes in the emulsion; dyes of different colors absorb certain other colors. A pink dye absorbs yellow and green light so that, if a little pink dye is put into the emulsion, the film will be sensitive to yellow and green as well as blue light. This type of film is called "orthochromatic," "ortho" meaning true or correct and "chrome" meaning color. Typical orthochromatic films are:

	Weston Speeds		American Scheiner		
	Day	Tung.	Day	Tung.	Available in
Agfa Standard	12	4	17	12	Roll, pack
Agfa Super Plenachrome	50	32	23	21	Roll, pack
Eastman Regular NC	24	8	20	15	Roll, pack
Eastman Verichrome	32	16	21	18	Roll, pack

Cut films are single pieces cut to proper size to fit cut-film and plateholders for ground-glass focusing cameras. Packs consist of specially made holders containing 12 pieces of film which fit into ground-glass focusing cameras, used by pulling out of the pack the tabs which mask the pieces of film; these tabs are numbered from one to twelve. When using a film pack, be sure to pull the tab after each exposure. Also, when using either pack or cut-film holder, pull the slide from the holder or pack *before* making the exposure, and replace it before removing either the pack or cut-film holder from the camera.

Panchromatic.—Orthochromatic film has a higher speed than regular film as well as greater sensitivity to light of other colors. It also has somewhat more latitude. But this film is not sensitive to red and orange colors, so that objects of these colors still photograph darker than they should. Our third type, then, is film that has been treated with dyes to make it sensitive to all colors, and these films are called "panchromatic." Such film reproduces all colors in fairly correct proportion. It is also sensitive to artificial light, so that it is of great value for taking pictures by electric lights. Some of the best known panchromatic films are:

	Weston Speeds		American Scheiner			
	Day	Tung.	Day	Tung.	Available in	Type
Agfa						
Superpan Supreme	50	32	23	21	Roll, pack, 35mm.	B
Superpan Portrait	24	16	20	18	Cut	B
Finopan	24	16	20	18	Roll, pack, 35mm.	B

Superpan Press	100	64	26	24	Roll, pack,	B
Eastman						
Super X X	100	64	26	24	Roll, pack, 35mm.	C B
Panatomic X	24	16	20	18	Roll, pack, 35mm., cut	B
Panchro Press	50	32	23	21	Cut	C
Plus X Pan	50	32	23	21	35mm.	B
Portrait Pan	24	16	20	18	Cut	B
Super Panchro Press	100	64	26	24	Cut	C

Panchromatic films may be divided into two subclasses: types B and C. Type B materials are highly sensitive to colors in the same way as is the human eye; type C materials have a higher sensitiveness to the orange and red colors. Type B are called "orthopanchromatic"; type C materials are called "hyperpanchromatic." In the table above, we have indicated the type for each film, and this information is necessary only for the use of filters (see next chapter).

Though films are made sensitive to light of all colors, they are still more sensitive to blue light than to others, and will photograph blue objects lighter than they really are. White clouds photographed against blue sky are lost unless we use a yellow transparent gelatin in front of the lens to absorb the extra blue light. These gelatins used before lenses are called "filters," and are discussed in the next chaper.

Choice of Film.—So many films are being sold today that it is rather difficult to know which one to use, and different persons prefer different makes and types of films. A few general rules may be followed in the selection of film:

For general photography, either indoors or outdoors, a good, fairly fast, orthochromatic film will do, though many photographers prefer to use panchromatic film all the time. For photographing colorful objects always use panchromatic film. For making pictures from which you intend to make enlargements, especially for scenic or landscape pictures, use a fine-grain film, such as Eastman's Panatomic or Agfa's Finopan, in which the crystals of silver bromide are tiny, so that the enlargement will not show too much "grain" or mottled appearance.

Handling of Film.—All film must be handled carefully in order not to scratch it, as the scratches will show up in the prints. Roll film must not be wound too tightly or it will "cinch" and show marks in the pictures. All panchromatic films must be developed in total darkness, as they are sensitive to even the dim red "safelights." Cut film comes in dozens and must be loaded into cut-film carriers or holders to be used in the camera. Roll film or film packs, of course, can easily be placed in the camera, even in daylight, but cut film must be loaded in total darkness.

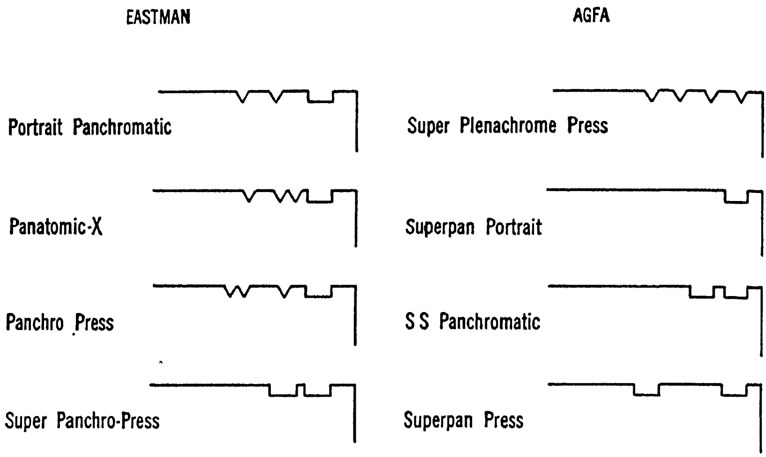


FIG. 20. FILM NOTCHES

In order to help the photographer get cut film into holders proper side up (emulsion), the manufacturers have marked the various kinds by means of notches cut out of the top edge on the right-hand side, when the emulsion is facing up. These marks serve to tell one kind of film from another, when handling it in the dark, but the notches also help in loading. Notches for some of the panchromatic films listed above are shown in Fig. 20.

There are many notches besides those given in the figure. It is not necessary to learn all the notches, or even any of them, but the

knowledge sometimes helps to keep things straight. Whenever you use a new cut film it is a good idea to learn its notch.

Both Agfa and Eastman make a great many films besides those we have listed (commercial, graphic, press, miniature, and movie films) and there are other makers issuing good film, including:

Defender (ortho and pan and other commercial films)
Du Pont (miniature camera films and movie films)
Gevaert (ortho and pan and movie film)
Hammer (ortho films and plates)
Hollywood (8 mm. and 16 mm. movie film)
Ilford (pan and commercial film and plates)
Pellex (8 mm. and 16 mm. movie film)
Perutz (35 mm. film)

Chapter VI

OTHER PHOTOGRAPHIC TOOLS

FILTERS

BESIDES the accessory lenses of different focal lengths, and attachments for telephoto, wide angle, portrait, or diffusion mentioned at the end of Chapter II, and which are, in fact, lenses themselves, there are some other lens attachments. At the end of the preceding chapter we mentioned the fact that even the panchromatic film does not record colors exactly, but is still more sensitive to blue than to other colors. In order to overcome this deficiency, and to obtain certain effects, lens attachments known as "filters" must be used.

This subject of filters is quite extensive, since it is difficult to know just what filters to use for different purposes. Filters consist of colored gelatins mounted between optical glass. The best type are mounted between the best grade of optically pure and hand-surfaced glass, but these are expensive, and the second grade will do for most purposes.

Absorption.—We have just said that the yellow filter absorbs blue light. As the basic action of all filters depends upon the colors they absorb, we should know what colors each filter will absorb before discussing individual filters. White light is made up of all the colors combined; this light may be broken up into the individual colors by passing through a triangular piece of glass called a "prism." This resulting band of color, ranging from red at one end to blue and violet at the other, is the spectrum.

Figure 21 shows the three principal colors that may be filtered out of the light coming from our object, together with the portions

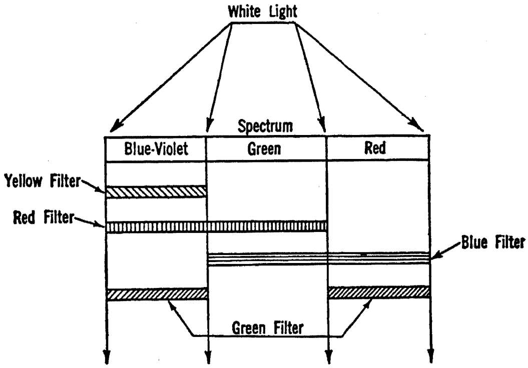


FIG. 21. ACTION OF FILTERS

of this color band or spectrum that are blocked or removed by filters of various colors as shown. The filters thus act as follows:

Yellow	absorbs blue light	transmitting the red and green
Red	absorbs the blue and green	transmitting the red
Blue	absorbs red and green	transmitting the blue
Green	absorbs both blue and red	transmitting the green

Use to Alter Color Values.—Filters are used to obtain special effects in one of two different ways. One way is by *correction*, the other is by *contrast*. Since even our best films do not reproduce colors exactly, filters may be used to see to it that colored objects are reproduced in their proper brightnesses, that is, more nearly as the human eye sees them. These are "corrective" filters.

Sometimes we want to make one color stand out more brightly than others, and for this purpose also we may use filters. Such filters are "contrast" filters. Corrective filters are usually yellow or green, while contrast filters are red or orange.

To use filters correctly we must know what colors we want to make brighter or what colors we want to make darker. The fol-

lowing table shows what filters to use for making colors lighter or darker:

Color in Subject	Filter to use to make it lighter	Filter to use to make it darker
Blue	Blue	Yellow, red, or green
Green	Green	Blue or red
Yellow	Yellow	Blue
Red	Red	Blue or green

From this table it is apparent that the filters used to darken colors are those that *absorb* the colors and the filters used to lighten them are of the *same color* themselves. This last is true because filters readily pass light of their own colors, thus permitting these colors to register quite heavily on the film.

Common Uses for Filters.—One of the commonest and simplest filters is the "sky filter," made up with the lower half clear glass and the upper half a light yellow. The yellow absorbs some of the blue of the sky, causing the sky to appear darker in the picture. This brings out the white clouds and makes a better picture. A full yellow filter can be used to better advantage: it will not only darken the sky, but will give some correction to the rest of the picture as well (see below).

A red filter, since it also absorbs blue light, can be used for the same purpose. This gives the picture an accentuated effect that is both pictorial and pleasing. Red filters, which have become quite popular, are especially useful for making distant shots of landscapes, as they can penetrate the haze which so often prevents objects at great distance from recording clearly.

The commonest uses for the best known and most used filters are listed in the table below. The filters are referred to by their letters in the Wratten series:

Filter	Color	Used For
K1	Pale Yellow	Landscapes with no bright color or sky, to give slightly better rendering of greens and yellows, especially when short exposure is needed (see factor table on page 52).

K2	Medium Yellow	Landscapes, to darken sky and make foliage lighter; to improve marines, snow scenes, and flower pictures. Is the best all-around filter for outdoor work.
G	Orange-yellow	Haze cutting, as in mountain pictures or extremely distant shots. Also for giving better texture rendering of subjects in sunlight under blue sky.
A	Red	Making dark skies, as for spectacular cloud studies and light-colored objects against a blue sky. May also be used to accentuate cloud pictures, giving pictorial effect.
X1	Light Green	Correcting both sky and foliage in pictures where correction is desired for both.

NOTE: The above filters are used chiefly for outdoor work, though the action is the same for subjects photographed under artificial light. The K series is not used indoors. The A, B (green, used to brighten green objects and darken red and blue objects), and C5 (blue, used to darken red and yellow or to lighten blue) are more suitable for indoor work. The X2 filter, which is a medium green, is especially good for making portraits under artificial light, as it reduces the excess red that is present in the light.

Any of the filters can be used for making photographs of other pictures, drawings, documents, etc., to eliminate stains from these subjects. For example, if a picture has a green stain on it, this stain can be eliminated by photographing the picture through a green filter. This type of photography is called "copy work" (see page 111). The best filter to buy, if you are going to have only one, is probably the K2. If you are going to have two or three filters, add X1, G, or A.

Filter Factors.—The filter, not being clear glass, cuts out some of the light reflected from the subject. So that the exposure, when a filter is being used, must be longer than it would normally be without the use of the filter. The number of times the exposure must be increased is called the "factor" of the filter. This means that if a filter factor is 1.5 ($1\frac{1}{2}$) the exposure would have to be $1\frac{1}{2}$ times as long as without the filter. If we take a picture of an

object or a subject, and find that the exposure should be ½ sec. without a filter, then with a filter over our lens that has a factor of 1.5 (for the particular film we are using), our exposure will have to be 1½ times ½ or ¾ second.

These filter factors are not the same for indoor picturetaking, under artificial light, as they are for outdoor, daylight photography, nor are they the same for different types of film. Many films, mostly cut film, include directions in their packages for the use of filters. Also, there are little pocket calculating devices that indicate the proper exposure for different types of film for all the best known filters, showing the exposure for the different f: stops. If you do not have one of these filter guides, or special instructions for the particular film you are using, you may use the table given below.

In the list of panchromatic films on page 44 the films are marked either type B or type C. Because the type C films are more highly sensitive to orange and red than the type B, when they are used with orange or red filters they do not need so long an exposure as would the type B. In other words, the filter factor need not be so great for type C films as for type B. In the following table the factors are given for orthochromatic films and for types B and C of the panchromatic, for the popular filters.

	Orthochromatic		Panchromatic			
			Type B		Type C	
	Daylight	Artificial light	Daylight	Artificial light	Daylight	Artificial light
K1	2	1.5	1.5	1.5	1.5	1.5
K2	2.5	2	2	1.5	2	1.5
G	5	3	3	2	2.5	2
A			7	4	4	2
B	8	4.5	6	6	7	6
C5	3	3.5	5	10	5	10

Neither B nor C types of panchromatic film are relatively as sensitive to blue as is the orthochromatic, so that the factors for the C5, or blue filter, are much higher for the panchromatic film.

OTHER ACCESSORIES

Besides the filters and the portrait or diffusion disks (which were discussed in Chapter II), one or two other accessories are also used on the lens.

One of these is the polarizing filter, which is a sort of lens designed to polarize the light that enters the lens. The working and uses of the polarizing filter are discussed in Chapter XI.

Lens Hoods.—Another photographic aid that attaches to the lens is a hood. The hood is used to shield the lens from the sun whenever the camera is placed with the sun on either side, at a front angle, or immediately in front, and it is also used to keep stray light rays out of the lens for indoors and under artificial light. It is true that the lens can be shaded with the hand, and sometimes the photographer can stand in the shade of a tree, building, or other object, but the use of a lens hood leaves the hands free for other work. These lens hoods are simply metal boxes or funnel-shaped devices, square or circular. Some circular lens hoods are made adjustable, so as to fit several sizes of lens. Lens hoods are more than just sunshades and should be used most of the time.

Tripods.—A tripod is a camera support made with three feet or legs simply because two legs would not permit it to stand unsupported, and four legs, or more, would only be in the way.

No exposure of less than 1/25 sec. should be made without using a tripod as the picture is likely to be blurred because of movement of the camera. Exposures faster than 1/25 sec. are improved by using a tripod, and *any* movie scene should be made with the camera on a tripod because it is almost impossible for the photographer to hold the camera still enough to prevent the picture's appearing jerky, which is hard on the eyes. For making pictures of landscapes, with filters that greatly increase the length of exposure, or for making pictures indoors in moderate light, a tripod is a necessity. Only news or record shots, sports pictures, or pictures of moving objects require fast exposure. Most pictures are taken at a more normal speed, and even a speed of 1/25 sec., such as is

used in many box cameras, will often show camera motion. It is best to use a tripod whenever possible, with any camera, as it improves the quality of the pictures.

The best type of tripod is one that is sturdy and without too many extensions, or too many joints to snap, clamp, or screw up, and consequently too many joints to work loose. The tripod should be fairly heavy, so that it may stand firmly and without jar. Figure 22 shows a sturdy, three-section (two-extension) wooden tripod. However, it is not always convenient to carry a heavy tripod up a mountain or on a long hike, so that a lighter one may be used for these occasions.

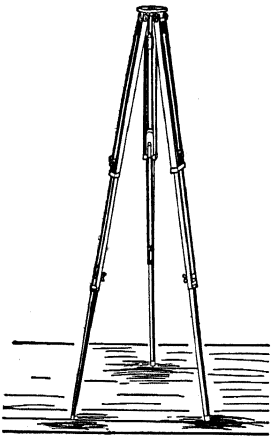


FIG. 22. TRIPOD

There are some variations on the tripods in use. For example, there is a "unipod" which, as the name indicates, is a single leg. This may be used simply to steady a camera, and to eliminate up-and-down jerky motion for movies. Then there is the Kodapod, which screws into the camera, but has no legs. Instead of legs it has a jaw with teeth, held together by a spring. This device may be used for fastening the camera to the limb of a tree, to a fence rail, or any other wooden object, while in the field. The Optipod is like the Kodapod, but has no teeth in the jaw. This is used for fastening the camera to the edges of tables, desks, or other furniture, without marring the finish.

Tripod Heads.—Both the Optipod and the Kodapod permit the camera to be tilted at angles. The regular tripods have flat tops, with no provision for tilting the camera up or down or to either side. For this purpose there are devices that may be fastened to the camera and to the tripod. An ordinary tilting top permits the camera to be tilted to an angle of 90°, at which tilt it is pointing straight down. A tilt-pan head normally permits the camera to be

tilted, but is arranged so that it can be turned also to right or to left without moving the tripod legs. This device is especially useful for movie cameras, for following moving objects or for moving the camera through the arc of a circle, as in the photography of scenery. As this type of shot is called a "panorama," a tripod head for the purpose is called a "panorama," or "pan" head; if it is built to tilt as well, it is called a "tilt-pan" head.

The tilting motion in some of these heads is furnished by a ball and socket joint, which permits the side motion also, but the regular heads have the two motions in separate joints, with separate clamps. One type has a bar or rod about 12 inches long, extending from the head, which can be used to tilt or to swing the camera. The handle of this bar, when twisted as one tightens a set screw, clamps the camera into position (see Fig. 23).

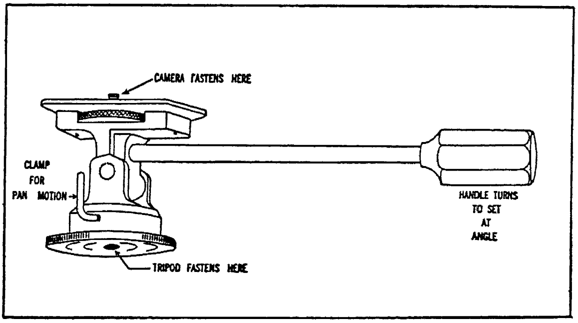


FIG. 23. TILT-PAN HEAD

Carrying Cases.—A camera, when not in use, should be kept covered, and nearly all cameras provide some sort of case for this purpose. Some cases are made of cloth but most are of leather, and since they have handles, and many even have shoulder straps, they are called "carrying cases." The shoulder strap, of course, permits the case to be slung from the shoulder, thus leaving the hands free.

Some carrying cases are made so that the front may be opened quickly, and the camera used to take a picture without actually

removing it from its case. Such cases are called "ever-ready," or "field," cases. They are usually made so that the film-turning knobs and range and view-finder windows, as well as windows through which one reads the number of the exposure on the film, can be seen without opening the case. These cases are used chiefly for miniature cameras, and are handy for quick picturetaking.

Some carrying cases are built like small suitcases, having partitions for holding not only the camera, but extra film or film holders (as in the case of cut film), filters, and other lens attachments, including hoods and supplementary lenses.

Film Holders.—Film holders for cut film are flat metal cases built to hold one film or one plate each. They fit into the back of view cameras and replace the ground glass, which is itself fastened to a holder of the same size to fit into the same grooves. Cut-film holders have metal slides that slip into slots immediately in front of the film. These slides must be pulled out before the exposure is made, and replaced when the picture has been taken before removing the holder from the camera. The slide contains no sensitive materials, and many good pictures have been taken "on the slide." Also, if the slide is not replaced, when the holder is removed from the camera the film will be immediately exposed to full light, and become hopelessly fogged. Some holders, especially older types, and usually made of wood, are double. These have a place for cut film or plate on each side, with a separate slide for each.

Film-pack Holders.—Film packs are built like cut-film holders, to fit into the grooves in the back of view cameras. They are, of course, much thicker than cut-film holders, because they are built to hold a pack of 12 pieces of film. The pack is loaded into the film-pack holder, slipped into the camera, and all the films exposed before the holder need be removed from the camera. The holder has a slide which must be removed before taking any pictures, and may be replaced to take the holder out of the camera before the pack in it is all exposed. The pack itself has a blinder sheet for each film, and these sheets, numbered from 1 to 12, extend above

the top of the holder. The sheet must be pulled from the holder and torn off after each exposure, and the pack itself must not be taken out of the holder (except in a darkroom) until it has been entirely exposed. Pulling the last sheet from the holder automatically blinds the pack (see Fig. 24).

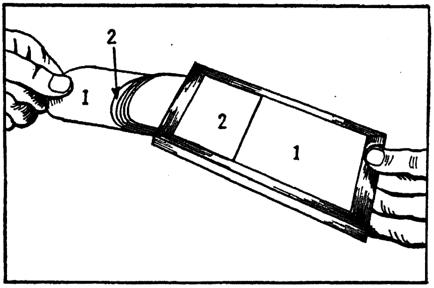


FIG. 24. FILM PACK

Roll-film Holders.—Roll film, of course, is simply loaded into the camera and turned up from exposure to exposure until all have been made, when the exposed film is rolled clear up and removed from the camera. Some cameras designed to use cut film or packs have attachments for using roll film, and these attachments, containing the rollers and a knob for turning them, fit into the same positions as do cut-film or film-pack holders.

Lighting Equipment.—For taking any kind of picture indoors you will need some lighting equipment. The ordinary light bulbs used in our homes are not bright enough to permit exposures short enough to record persons and objects plainly without the danger of showing motion. Since it is difficult for a subject to hold a pose for much longer than 1/5 sec., special light bulbs have been made for lighting subjects to be photographed. These bulbs are called "photoflood" bulbs and are made in several sizes. The small size (No. 1) is equal to 750 watts of light; the No. 2 gives nearly double the illumination. The other sizes are of even greater strength. These bulbs have a short life; the No. 1 will burn for about two hours and the No. 2 for about six hours. Therefore, they should be used

only for focusing or making the actual exposure, and turned off when not in use.

These lights require reflectors so that their full light value can be used. Ordinary cardboard reflectors can be used or permanent metal reflectors can be purchased at low cost. There are regular folding stands made for holding these lights (see Fig. 25), and some types of reflectors have swivel joints on spring clamps that can be clamped on to furniture. There is also a bulb with reflector built into the glass, which requires no additional reflecting device.

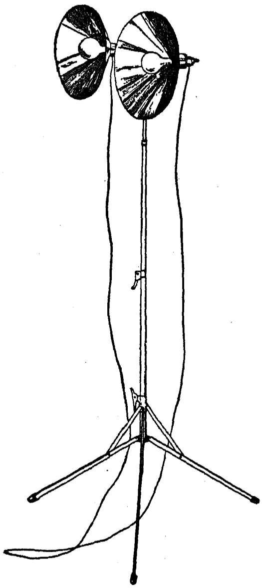


FIG. 25. KODAFLECTOR

When photoflood bulbs are used to illuminate a subject the length of the exposure can be determined by use of an exposure meter. There is, however, a more or less standard table of exposures for photoflood bulbs, which depends upon the number of bulbs and their distance from the object being photographed. This table is given in Chapter VIII.

Flash Bulbs.—Besides the photoflood type of electric bulb there is the flash bulb, which, as its name indicates, gives a brilliant flash of light lasting for only a fraction of a second. Such bulbs can be used only once. Flash bulbs are of two sorts, one containing crumpled foil and one containing wire. They require little electric current to flash them. Even a small hand flashlight battery will do it.

Flash bulbs can be used for making indoor pictures of children, because it is hard for children to keep their eyes open when facing bright lights such as photofloods, or they can be used for taking pictures of groups of persons, or for making pictures of pets, such as dogs and cats. Flash bulbs can be used also for making outdoor pictures at night, and it has been discovered that they improve

many outdoor daylight pictures as well, by lighting the subject on the side away from the natural light. For this use of flash bulbs see page 70.

These bulbs may be used with cameras in two ways. One way is to hold the reflector containing the flash bulb in one hand, whether the source of electricity is a simple flashlight battery or the bulb is in an ordinary socket on a cord plugged into an electric light circuit. When ready to take the picture, the camera shutter is opened on bulb, the bulb is flashed, and the shutter is permitted to close. For this work the foil bulbs are satisfactory.

The length of the exposure for a flash bulb, of course, depends upon the length of the flash itself, a fraction of a second. But if the diaphragm is opened too far or if the bulb is too close to the subject for the f: stop used, the picture will be overexposed; if the bulb is too far away from the subject for the f: stop used or if the diaphragm is closed too far for the distance from lens to subject, the picture will be underexposed. So that the use of the flash bulb depends upon the distance from the subject, the f: stop, and the size of flash bulb. A table, prepared for the standard sizes of foil bulbs, follows:

Distance to Subject	No. 20 Bulb (large)	No. 10 Bulb (small)
6 ft.	f:16	f:11
10	f:11	f:8
15	f:8	f:6.3
20	f:6.3	f:4.5
25	f:4.5	f:3.5

These are for Verichrome or Panatomic-X speed films. For faster films, such as Super-X, use one stop smaller. (Also, use tables provided by the manufacturers of the bulbs.)

The Synchronized Flash.—Another way of using flash bulbs is by what is called a "synchronized flash," which is a device for synchronizing the flash with the shutter. For taking pictures of posed subjects, with the camera on a tripod, the first method is satisfactory, but the synchro-flash is of great value for taking news shots, where the photographer must hold the camera; he does

not have enough hands to hold and operate other equipment at the same time. The synchro-flash is a necessity for taking rapidly moving objects, such as in sports pictures, and is also needed for "candid" shots.

In the synchronized flash the action of the flashing device is synchronized with the action of the shutter, and several styles of "guns" are made. One is the Kalart Speed Flash, which has a switch device that screws into the cable release socket on the shutter. The cable release then screws into the top of the switch mechanism, and, when the cable release button is pressed, the shutter is released and the flash made at the same time. Another type is the Mendelsohn, which has a trigger on the side operating both flash and shutter. There is also the Abbey gun, which has an "electric finger" that trips the shutter.

The table given above can be used with synchro-flash, with the shutter speed set at anywhere from 1/25 to 1/100 sec. It is preferable, however, to use exposure tables supplied with the bulbs, as the figures vary according to kind of film, kind of camera, and size of bulb. Wire bulbs are somewhat better for synchro-flash work, and are especially recommended for use with focal plane shutters, because foil bulbs do not give even enough exposure. The Wabash Superflash No. 2 has a "long peak" especially suitable for miniature focal plane shutter cameras such as the Leica.

Part II

PICTURETAKING

Chapter VII

OUTDOOR PICTURES

EXCEPT that the exposure and aperture will vary according to different lighting conditions, the camera is operated in the same way, whatever outdoor subject is being photographed. But the subject itself varies greatly in brightness, in color, in size, in shape, in distance from the camera, and in motion. The variation in brightness changes the length of the exposure, but this we can compute by using an exposure meter or by the use of the exposure table given below. The other variations may affect our choice of film, posing of subject (if living subject), and composition.

OUTDOOR EXPOSURE TABLE

For Verichrome or Panatomic films in bright sun from one hour after sunrise to one hour before sunset:

	Shutter Speed	Lens Openings f: System	Lens Openings 1-2-3-4	Box Cameras	Miniature Cameras
In bright sun, but without prominent dark object in foreground (marine and snow scenes, distant landscapes)	1/25	f:22	3	I with next to largest opening	1/100-f:16
Bright subjects, with foreground objects (people in beach or snow scenes)	1/25	f:16	2	I with largest opening	1/100-f:11

	Shutter Speed	Lens Openings f: System	Lens Openings 1-2-3-4	Box Cameras	Miniature Cameras
Average Subjects ***not in shade*** (people, gardens, houses)	1/25	f:11	1	I with largest opening	1/100-f:8
Shaded subjects (open shade, lighted by open sky)	1/25	f:8 f:7.7	½ sec. at 3	½ sec. at smallest opening	1/100-f:6.4
Dark subjects (under trees or porch roofs, in good light)	1/25	f:6.3	1 sec. at 3	1 sec. at smallest opening	1/100-f:3

With faster film, such as Super XX or Super Panchro Press, use smaller opening.

Use next larger opening for hazy sun; second larger for cloudy-bright conditions; third larger for cloudy-dull conditions.

To use smaller or larger opening (under same light conditions as in table), increase or decrease exposure by doubling or cutting in half, for each smaller or larger opening.

Equipment.—The following is a list of equipment for outdoor photography:

Camera and case.

Range finder, if not built in.

Exposure meter.

Filters: K2, A or G.

Film: Orthochromatic (such as verichrome) is satisfactory for much outdoor work, but panchromatic makes better pictures and should always be used for color correction.

Tripod.

Synchronized flash and bulbs (see below).

Some Things to Remember.—Be sure you have the correct focus (use range finder, if you have one, to secure accurate distance to the subject).

Be sure to wind the film after exposure or, if you are using a film pack, be sure to pull the next tab. If you are using cut film or

plates, be sure to replace the slide before removing the holder from the camera.

For best results do not use orthochromatic or panchromatic film earlier than one hour after sunrise or later than one hour before sunset (the sun's light is not strong at these hours even though it may appear to be quite bright).

Some Suggestions.—Do not make an exposure slower than 1/25 sec. without a tripod.

If you are holding the camera in your hands, it is best to lean against a tree or some firm support.

Watch the subject in the view finder while making the exposure.

Study the image in the view finder or framer to make sure you have a pleasing picture with proper lighting.

Do not get closer than 6 to 8 feet from the subject if you are using a fixed-focus camera (some box cameras have the diway lens, which includes a little supplementary lens which can be held out of position for pictures closer than 10 feet).

It is best to have a center of interest in the picture, though this should not be in the exact center of the picture.

It is not wise to have the subject facing the sun. It is better to have the sun at one's side, so that the subject need not squint.

For pictures of persons, try to choose a suitable background. It is better to use a background that will contrast harmoniously with the subject's clothing.

It is best not to have the subject's hands or feet closer to the camera than the rest of the figure. Otherwise there will be considerable distortion, and the hands or the feet will appear too large.

Be careful of the angle at which you shoot. It is a good thing to try new and interesting angles of view and it is also a good plan to make the same shot from different angles so that you can select for the finished picture the one that is most pleasing.

OUTDOOR SUBJECTS

As said in Chapter I, nearly everything can be the subject for a photograph, and outdoor subjects for ordinary snapshots are usually

people. But there are other types of outdoor pictures, and the photography of these special subjects is discussed in Chapter X. General outdoor photography must include pictures of landscapes, pictures of moving objects, and night pictures.

Landscapes.—A landscape picture is one of a stretch of country taken from a particular viewpoint, as, for example, an elevated position. A good landscape picture should be scenic and pictorial. By pictorial we mean, of course, that the picture is pleasing to the eye and follows the rules of good composition. A landscape should not be made just as a "snapshot." It will be a better picture if it has been studied out beforehand and carefully composed in the view finder (see Illus. 1).

There should not be too much detail included in the picture. A single tree standing above the horizon may make a better picture than a whole forest of trees, though the forest will also make a good picture if the angle is right, the lighting correct, and the composition carefully considered. A good landscape should be simple and not overcrowded. It should have only one main mass or object, to which the eye is led.

Beware of taking a picture of a road that seems to be blocked by trees or other objects, because the person looking at the picture feels "shut in." There must be some "escape" from the picture for the eye or the viewer may dislike it instinctively.

You must watch shadows carefully and see to it that the exposure is long enough for them to have detail and not be blocked. The picture cannot have what is called "depth" (in which the subject seems to stand out from the rest of the picture) unless there can be good tones. This matter of tone means sufficient exposure so that there will be both dark and light portions, and the dark and light portions must be rather carefully balanced to be pleasing. If the shadows are too dark, no detail will be visible and the eye is given the impression of a big black mass, which may produce the sensation of frustration, or even fear.

These shadows, of which we have been speaking, cannot be ob-

tained if the sun is directly back of the camera, and without them a picture is "flat." The sun should be at one side, but it may be directly in front, or at an angle, if the lens is properly shaded.

To give a landscape "life," put a human figure in it. The human figure (at some distance, and faced away from the camera, so that it will not dominate the picture) makes a landscape much more cheerful, and this quality should be present in all pleasing landscape pictures. If the main object in a landscape picture is large, such as a mountain peak, it is accentuated by a small human figure. As we have said, the figure should not be so large that the picture becomes a portrait, for then we have lost what we set out to photograph—the landscape.

One good type of the scenic picture is what is called a "vista." This is a picture of a distant scene as it appears between objects in the foreground, such as trees, or large rocks, or even buildings. The focus may be made for the distant object; then the near-by objects will be somewhat diffused and serve only to accent the main picture. Another good type of vista can be made by photographing a road winding into the distance between trees. If the road goes directly out of the picture in the background, be sure that the end is not closed by trees, or other objects, and that the sky comes down to the horizon, where the road disappears. A picture of this sort is pleasing to the eye; the eye not only "escapes" from the picture, but the imagination gives it additional charm by speculating on what may lie beyond the turn or the end of the road.

Clouds.—Clouds add to scenic pictures. Many a good picture has been spoiled by lack of a good sky. Clouds serve to balance a picture containing comparatively little background. Don't forget to use a K2 or red (A) filter to secure cloud outlines against a blue sky. If the extreme background or distance of the scene is hazy, remember that the red filter can cut this haze and give good definition even on the extremely distant portions of the picture. If you have a good scenic view and the light is just right, you need not reject it simply because there are no clouds in the sky. You can secure good cloud

pictures some other day, and include them in your finished picture by double printing (see page 201).

Against-the-sun Pictures.—For many years it was considered impossible to take pictures against the sun for fear that the light itself would enter the lens and fog the film, but today many pictures are made with the light coming directly toward the camera. This arrangement is used to secure shadows facing the camera (effects formerly never reproduced) and to secure edges of light around the subjects. These edges of light accentuate the subject and increase the beauty of a picture, and the long shadows give it depth.

Subjects for against-the-sun photography must be chosen with some care, though almost anything can serve as a subject if properly handled. Buildings, for example, are not really good subjects, because it is usually desired to show detail in building pictures, and this cannot be done if the light is on the opposite side. Sometimes beautiful against-the-sun pictures can be made of columns and pillars or building arcades, with long shadows of the columns extending toward the camera in beautiful symmetry.

A lens hood should be used for all against-the-sun pictures, not only to keep out direct rays of light but to prevent stray rays from entering the camera. If the sun is directly in front, some other shading or shielding of the lens may be needed, and this can be done with the hand or other object. The sun itself can be included in the picture if it is partly hidden or dimmed by mist or light clouds.

Landscapes are good subjects for against-the-sun pictures. Even a fairly dull expanse of meadow can become quite pictorial when photographed in the mellow light of late afternoon and with the shadows pointing toward the lens. Seascapes are also good, especially with the glistening or shining effect created by sunlight coming toward the camera. These pictures should be exposed neither for the bright shining parts nor for the dark portions, but by averaging the two. Silhouettes are fairly simple by the against-the-sun process, since you do not care whether or not the subject is clearly shown

so long as its outline is distinct and the background contrasts with it. Sky is the best background for outdoor silhouettes, and the exposure, in this case, should be fairly short so that the foreground object (your subject) is not shown distinctly but becomes a silhouette. Always use a yellow filter for against-the-sun pictures.

Moving Objects.—Many outdoor pictures must include moving objects. This is true of sports pictures and it is true of landscapes including, for example, a herd of cattle. If you have moving objects, the exposure cannot be long, and you can seldom use a filter at all, as the filter factor makes for so long an exposure that the motion would show and spoil the picture. If the objects are moving rapidly, the exposure must be extremely short. A moving object is usually comparatively small—a single figure, a horse, an automobile, an airplane—and this is fortunate because the focus can be made for the object itself. We do not greatly care if the remaining portions are in sharp focus or not. This means that we can take our picture of the moving object at wide or full aperture.

To secure enough light so that the exposure can be short, even with wide aperture, the subject should be in the sunlight. Unless you have a very fast lens you cannot take pictures of rapidly moving objects in dim light.

Another matter enters into the photography of rapidly moving objects, and that is the direction of the motion. The farther the object is from the camera the less danger there is that the motion will show in the picture, and we want to avoid the motion showing if possible. In other words, we want to "stop" the action, taking a picture of an athlete in mid-air, in the midst of a broad jump, or catching a picture of a speeding automobile, stopping the motion so that the object will be in focus and not appear simply as a blur.

If the object is moving toward or away from the camera it can be photographed at fairly close range, perhaps 40 feet, though if it is moving directly across the line of sight it should be much farther away. The best pictures of moving objects are made when the subject is moving diagonally across the field of view.

DAYLIGHT FLASH PICTURES

The flash bulb can be used outdoors, not so much to supplement sunlight as to illuminate sides of subjects away from the sun (in the shadow), and especially to secure new or novel lighting effects. If the model is between you and the sun, for example, you will secure a back-lighted effect, but you cannot expose properly to bring out both the background and the side of the subject facing the camera without the use of a flash.

The exposure should be determined as though no flash bulb were to be used at all, that is, it should be calculated for the background rather than for the subject. Then let the flash bulb take care of lighting the side of the subject or model facing the camera. Flash bulbs may be used for lighting subjects posing in deep shade; they do not spoil the effect of the shade itself.

The flash can be used to illuminate subjects only at distances up to about 12 or 15 feet, and has no effect on the background. More bulbs can be used to build up a desired effect. The flash can give evener exposure to the faces, if several persons are posing in a group where the light is uneven and all persons are not in the same general position with respect to the sunlight, or if part of the group is in the shade.

You may also take a picture of a person inside a room, in front of a window, and still retain the detail outside the window. Set the exposure for the distant view (outside) and use the flash to light the darker subject in the foreground.

For all types of flash work outdoors you need a synchronized-flash mechanism, as described on page 60. The background would be badly overexposed if the shutter was opened on bulb and held until the flash was made, as the quickest the flash could be operated would be at least 1/5 sec. and the background requires an exposure not longer than 1/15 or 1/25 sec.

The length of exposure is calculated for the background and the aperture is set for the distance from the flash bulb to the subject, according to the following table:

Distance to Subject in Feet	One small Bulb	One large Bulb
6	f:16	f:22
10	f:11	f:16
15	f:8	f:11
20	f:6.3	f:8
25	f:5.6	f:6.3

With box camera use largest stop opening and distance as given for f:16 or f:11. If the camera is 10 feet from the foreground subject, the aperture used with one large-sized bulb should be f:16, and the exposure is set for this aperture, according to the exposure table or to meter readings.

NIGHT PICTURES

Night pictures outdoors offer a fascinating field for the photographer. They may be taken by means of either flash bulbs or natural or artificial lighting. A fast film should be used.

Moonlight.—Natural light, at night, must be from either the moon or the stars, and you must choose whether or not to include the moon in the picture. If the moon is to be *in* the picture, the subject will become a silhouette, or will at least be dark, though pictures of this type are pleasing and often beautiful. The reason a clear bright picture of the foreground subject cannot be made is that the light is so dim that a long exposure is necessary, perhaps many minutes. An exposure of the moon for that length of time would show it as a long patch of light shaped something like a banana, because of the earth's motion on its axis. You can make the picture you want while the moon is out of sight of the camera (behind tree foliage, for example) and then take a separate picture of the moon itself from the same position. This exposure need be only two or three seconds, with wide aperture. The final print may then be made by printing both negatives, by double printing (see Chapter XVII).

A picture made, not of the moon, but by means of moonlight, had better be of a landscape, seascape, or inanimate object, because the exposure will usually need to be from a half hour to an hour, or

even more, at medium aperture (for depth) and on fast film. Good subjects for such pictures are bodies of water, as the water reflects much of the light and permits a fairly bright picture. Use a tripod.

Moonlight Effect.—Moonlight pictures can be made by sunlight, by taking a scene just at sunset if there are clouds in the western sky so that the sun is partially hidden. The sun then looks like the moon in the picture. Moonlight pictures given about 4 times normal exposure give a daylight effect; daylight pictures given one-fourth normal exposure, or with red filter, give a moonlight effect.

Artificial Light.—Night pictures by means of artificial light include floodlighted buildings, street-lighted scenes, electric or neon signs, and even buildings with light shining from windows. These pictures are made by the reflected artificial light, including the lights themselves; for example, a picture of a building made visible by floodlights on it. They may also be pictures of the actual light sources, such as electric signs. Pictures of such signs, at fairly close range, require from 1/10 to 1/50 sec. with full aperture.

Pictures of floodlighted buildings require exposures ranging from a few minutes to a half hour, at medium aperture, the amount of light and the pictorial effect desired determining the time. Buildings lighted only by street lights require even longer exposure. It is better to overexpose than to underexpose in such cases, and proper exposure can be found only through experiment. It is a good plan to take several pictures, perhaps one at 5 minutes, one at 10, one at 20, and so on. One of these may give the effect you want to capture. Exposure meters can give you no help here; trial and error is the only method to use.

Do not include moving objects, such as automobiles, in long exposures, as they will make a blur in the picture. Automobile headlights can make streaks of light even in short exposures. In taking a picture across a street, for example, shield the lens with the hand when an automobile passes. Use tripod and lens hood and try to compose the scene so that no large dark patches will be included. Use fast film.

Flashlight Pictures at Night.—Another means of taking pictures at night is by use of flash bulbs. These pictures, of course, will be of objects not otherwise illuminated—a group around a campfire, several persons on a porch, or similar subjects. The distance-aperture table on page 83 can be used for this type of picture. But this use of flash bulbs differs from daylight flash pictures in one respect: you do not have to use the synchronized flash for these pictures, as there is no danger of overexposing the background. You may simply open the shutter on bulb or time, make the flash, and close the shutter.

COMPOSITION

The composition of a picture is the arrangement of subjects. For indoor pictures, of course, subjects, background, and lighting can be arranged for good composition. But for outdoor pictures the point of view must be chosen to secure a good arrangement of light and dark masses, and even the time of day will influence this. What might be a good picture in the morning may not be one in the afternoon.

Composition is an art that cannot be learned from a book; it depends largely upon the photographer's imagination and eye. However, some general rules can be learned and followed in composing pictures. There should always be a center of interest toward which the eye is led. A picture will contain several different "lines," and these lines should serve to lead the eye to the center of interest, which should not be the center of the picture. There should be only one main point of interest. Then see to it that this main point of interest is not overpowered or overbalanced by some other object in the picture and that the lines actually lead the eye to it. An object of natural or scenic beauty, such as a tree or large rock, may have a person as a secondary object in the picture. If this person looks toward the camera he "steals the scene" and becomes the principal point of interest. He should be looking at the main point of interest, and not be close to the camera.

The background should serve as a setting for the principal subject, and contain no lines that will spoil the effect. To "balance" a picture

properly the darker areas should not all be on one side or in one place and there should be neither spots too dark nor spots too bright of the same importance. Furthermore, the lines should never actually divide a picture into sections.

Illustration 2 shows some good composition and some that is faulty. The picture is diagramed in Fig. 26, and may be described

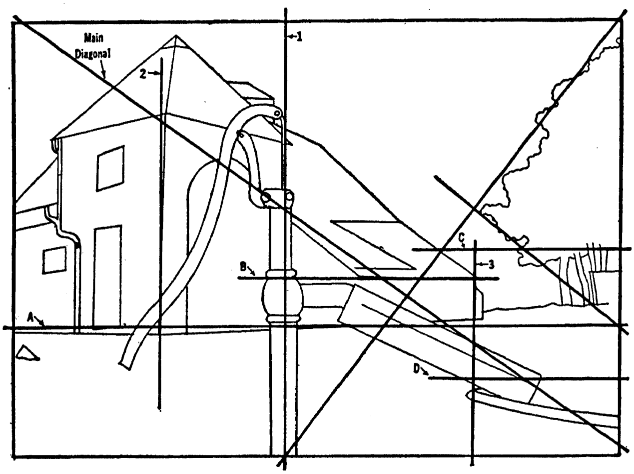


FIG. 26. COMPOSITION DIAGRAM FOR ILLUSTRATION 2. DESCRIBED IN TEXT

as follows: The main idea of the picture is to include a combination of curves and straight lines in shapes that build up in a similar way in both foreground (pump) and background (stone barn). The divisions of space are:

Main verticals: No. 1—Left of center.
No. 2—Left of center, cutting space at left.
No. 3—Right of center, cutting space at right.
(All distances between verticals vary.)
Main horizontals: A—About one-third up from base.
B, C, and D, at varying intervals above and below.

Main diagonal is from upper left to lower right, balanced by roof lines in the other directions, pump handle and edge of tree at right. Note the relation of the diagonals to important parts of the picture,

creating shapes of dark and light areas that accentuate the contrast of textures.

The main faults of the picture are: (1) The vertical line of the pump cuts perpendicularly into lower edge of picture. There should be some transitional line, and a darker spot in the lower left corner. (2) The picture is slightly underexposed; there should be more shadow detail in the barn. (3) A filter (K2 or X1) would have demarked the light-colored roof from the sky in the upper left corner. (4) Panchromatic film would have been better. (5) A smaller stop would have been better. (6) The enlarger was not focused sharply.

The lines of a picture can be used to give a desired effect to the viewer. For example, vertical, that is, tall and narrow, subjects should be treated in vertical pictures (long dimension up and down); horizontal, low or flat, subjects should be treated in horizontal pictures. Vertical lines make for dignity and horizontal lines give an impression of rest or peacefulness. Diagonal lines indicate movement and curves suggest gracefulness.

Though these things should be considered before making the exposure, many good pictures are made by using only the portion of a picture that has good composition. This practice is known as "cropping" (see Chapter XV, Enlarging).

It is not always necessary to take a distant shot at small aperture. The idea of depth can be secured by including some objects in the foreground with which the viewer can compare the rest of the picture. This practice is especially good for scenic pictures, but it will work for almost any outdoor shot.

Lighting is important to composition, too. Depth, or third dimensional effect, can be given a picture by including long shadows or side lighting and then exposing so that the shadows still show detail. Reflections, in the foreground, also help to give depth as they carry the eye into the picture and lead it to the principal object.

Chapter VIII

INDOOR PICTURES

INDOOR pictures may be made by daylight or by artificial light, and the artificial light may be either photoflood or flash bulb. The range of subjects for indoor photography is not so great as for outdoor, though the range of possible pictures is just as great.

DAYLIGHT PICTURES

Indoor Informal Portraits by Daylight.—These pictures need a rather long exposure, because the amount of daylight that comes through a window cannot begin to equal the outdoor light in intensity. The simplest type is the picture of a person standing or seated beside a window. Daylight coming through the window lights the subject from one side. A screen may be used on the opposite side to reflect some of the daylight back onto the subject so that that side will not be too dark (see Illus. 3 and the diagram, Fig. 27). Do not include too much of the window in the picture or the long exposure necessary to "capture" the subject will make the window too bright. When the subject is posed, note the shadow cast by the nose and place the reflecting screen to kill part of this shadow. For the reflector a sheet or piece of ordinary white cardboard can be used. It should be held or placed fairly close to the

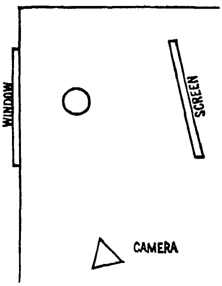


FIG. 27. DIAGRAM FOR ILLUSTRATION 3

subject. A little experimenting will show how both the subject and the screen should be arranged.

Backgrounds.—The best backgrounds are plain. They may be either walls or cloth curtains hung over the walls, provided only the curtains do not have any large figures or patterns. The background should be at least 3 feet behind the subject, and smooth.

The exposure can be determined by means of an electric exposure meter, if the light is strong enough, or by means of an extinction type of meter. It will probably vary from 1/5 to 1 sec. with the lens at full aperture, or nearly so, for lenses down to f:6.3. Exposures for box cameras will have to be much longer, perhaps several seconds for double lenses and as many as 5 to 6 sec. for meniscus lenses. Use some support for the camera; a regular tripod, an optipod, or a table.

Cameras with fast lenses, such as f:3.5 or f:2, can make regular snapshots indoors *if the light is good,* at a speed of 1/25 sec. Faster film will help to cut the length of the exposure.

Another interesting kind of picture can be made indoors by means of daylight. This is the picture taken with a window as a background, and is easy if done correctly. The incoming light should be diffused or softened by a thin curtain over the window. The side of the subject nearest the camera must be lighted by means of a reflecting screen if there are no windows on the other sides of the room.

Daylight Pictures of Rooms.—These pictures must have time exposures because the amount of daylight entering a room through the windows cannot light up the entire room sufficiently for short exposure. Also, the long exposure is necessary because a small stop opening must be used to get the necessary depth with the camera so close to the nearer objects. There should be no pieces of furniture near the lens, because distortion will make them appear too large in the picture.

Here, again, a tripod or other rigid support for the camera should be used, placed low enough so that there is more floor than ceiling in the picture, and there will be no reflections from mirrors or from

pictures on the walls. Screens may be used to reflect the light into the portions of the room being photographed, in the same way that they are used for informal portraits, but rooms with two or more windows can usually be lighted without the reflecting screens.

The light should be as even through the portion of the room being photographed as it is possible to get it, and should come from behind the camera or from the side. If rays of sunlight are coming through the window, you can probably capture them in your picture, but the exposure should be calculated for the darker portions of the room.

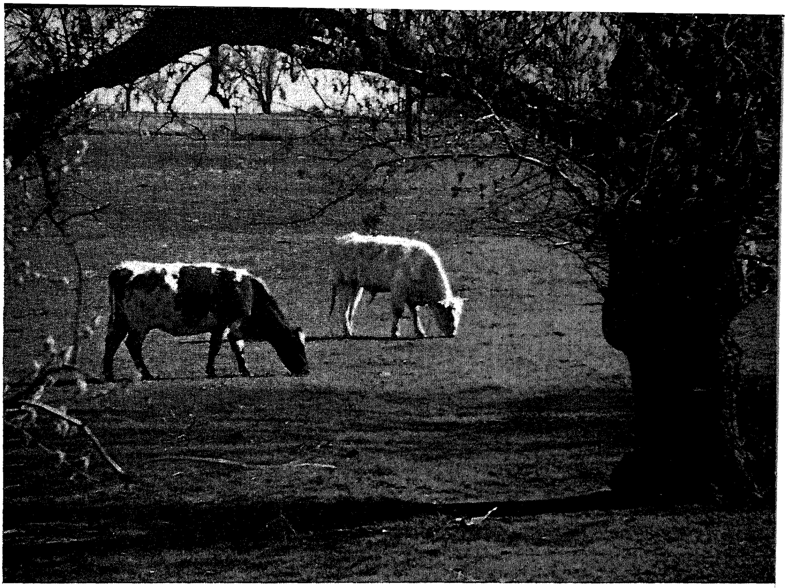
The exposure for as small a stop opening as f:22, for example, may require many seconds or even several minutes. To compute the exposure an extinction type meter may be used or the following exposure table, which has been made up for direct sunlight entering the windows, from three hours after sunrise to three hours before sunset.

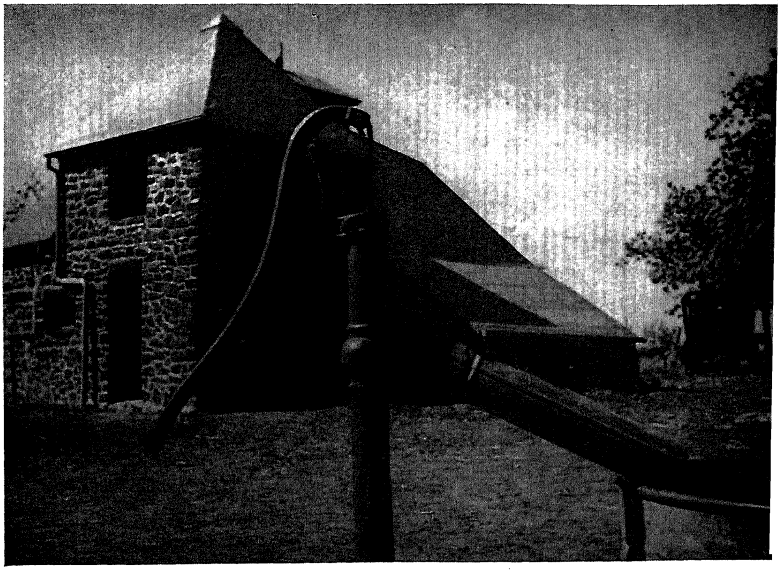
EXPOSURE TABLE FOR INTERIORS

For stop f:16 or second stop for box cameras.
Double exposure for each smaller stop.

	Bright Sun	Hazy	Cloudy Bright	Cloudy Dull
White walls, more than one window	4 sec.	10 sec.	20 sec.	40 sec.
White walls, one window	6 sec.	15 sec.	30 sec.	1 min.
Medium walls, more than one window	8 sec.	20 sec.	40 sec.	1 min. 20 sec.
Medium walls, one window	12 sec.	30 sec.	1 min.	2 min.
Dark walls, more than one window	20 sec.	40 sec.	1 min. 20 sec.	2 min. 40 sec.
Dark walls, one window	40 sec.	1 min. 20 sec.	2 min. 40 sec.	5 min. 20 sec.

Interesting pictures of interiors, *showing windows,* can be made by making two exposures on the same film. The camera must be placed across the room *facing* the windows. One exposure should be made with the windows covered by opaque black cloth. Make this exposure from 5 to 10 sec. Then make an exposure with the windows





1. Landscape. *Photograph by Claude Pilger*
Leica Camera, Supreme film, 1/60 sec., f:6.3, 90 mm. lens, green filter.
2. Pump and Stone Barn. *Photograph by Dwight Kirsch*
Zeiss Ikon Camera, Verichrome film, 1/25 sec., f:16. See Figure 26.

3. (*Upper Left*). INFORMAL PORTRAIT BY DAYLIGHT. *Kodak Recomar, Portrait Pan cut film, 1/10 sec., f:5.6.*
4. (*Upper Right*). PORTRAIT BY STANDARD LIGHTING. *Leica Camera, Supreme film, 1/40 sec., f:6.3.*
5. (*Lower Left*). PROFILE PORTRAIT. *Leica Camera, Supreme film, 1/30 sec., f:4.5.*
6. (*Lower Right*). MARIHUANA: POSED PICTURE. *Kodak Recomar, Portrait Pan cut film, 1/5 sec., f:5.6.*

uncovered; this exposure can be made at 1/2 or 1 sec. with small stop opening to get the picture outside the window. This exposure then helps to build up the exposure on the interior as well. Both exposures are made on the same film and *without moving the camera between exposures.* Another way to do this is to take the interior shot at night so that it is not necessary to cover the windows. Then take the exterior shot the next day. This method, however, does not give the daylight effect.

A picture can be made to include more of the room if a wide-angle lens is used, either a "slipover" attachment or a special lens to replace the regular one on the camera. Such lenses can be used only on view cameras or on cameras permitting focusing of short focal length lenses.

ARTIFICIAL LIGHT

Indoor Pictures by Floodlight.—Indoor informal pictures, such as mentioned in the preceding section, can be made much better by the use of artificial light. Such work is done best at night, for then there will be no extra light coming through the windows to make light streaks in the pictures. Any camera can be used, but cameras slower than f:6.3 will need short time exposures. For these lighted pictures use photoflood bulbs, which are made in four sizes. The small bulb gives an illumination of about 750 watts and will burn about two hours. The No. 2 bulb gives twice the illumination and will burn about six hours. One or more bulbs may be used and they should be fairly close to the subject. They may be used in ordinary bridge or table lamps, or in cardboard reflectors, or in regular metal lighting equipment, on folding stands.

The lights should be placed to illuminate the subject. A good arrangement is to have one on each side, or one on one side and one at the camera, placed with one closer to the subject than the other, so that the light from this side will be brighter than from the other. The picture will then not be "flat." One of the lamps should be higher than the other.

If the lights are used on only one side, something on the other

side should reflect the light. This can be a light-colored wall or even an ordinary white sheet placed over a chair back. Be sure that the reflector does not show in the picture and that the lights do not shine or reflect into the lens. Be careful of the strong shadows thrown by these brilliant lights. If the light is all on one side you will have shadows on the other side. A somewhat better arrange-

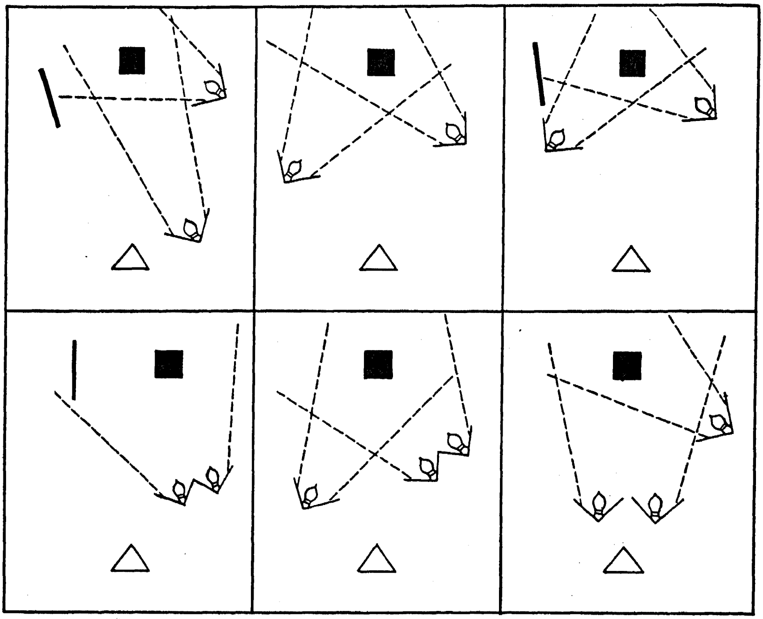


FIG. 28. INTERIOR GROUP LIGHTING DIAGRAMS

ment is to include a lamp (perhaps not quite so bright) on the other side to help to "kill" the shadows. Figure 28 shows several suggested arrangements of lamps and subject. The subject is shown as a black square, but remember that this may be one or more persons. Focusing can be done with ordinary light bulbs, in order to save the expensive, short-lived flood bulbs. Shades and other inflammable objects should be kept away from these brilliant floodlight bulbs when in use because they become hot.

The exposure will vary according to the number of lamps used

and the distance of the lamps from the subject. An electric exposure meter used fairly close to the subject is an excellent guide to the length of the exposure necessary for pictures of this type. In using the electric meter, be sure that you do not come between the light and the subject or this meter reading will be cut down because your body is cutting off much of the light. It is well to kneel down and hold the meter up at arm's length to secure the reading for pictures of this sort. The following exposure table gives exposures for both small and No. 2 bulbs (two bulbs), apertures, and distances from lamps to subject. This table is for light-colored interiors. The exposure should be doubled for dark interiors. Also, use exposure information supplied free by the makers of the bulbs.

Distance (in feet)	Diaphragm	2 No. 1 bulbs in metal reflectors	2 No. 2 bulbs in metal reflectors
4	f:4.5	1/50	1/100
4	f:6.3	1/25	1/50
4	f:11	1/10	1/25
4	f:16 (or Box camera)	1/5	1/10
6	f:4.5	1/25	1/50
6	f:6.3	1/10	1/25
6	f:11	1/5	1/10
6	f:16 (or Box camera)	1/2	1/5
10	f:4.5	1/10	1/25
10	f:6.3	1/5	1/10
10	f:11	1/2	1/5
10	f:16 (or Box camera)	1	1/2

Cut exposure in half to use new super speed films.

Give twice the exposure if using ordinary reflectors; give four times if using no reflectors.

To use one bulb only, double exposure; doubling number of bulbs halves the exposure.

Do not use more than three No. 2 bulbs on a single-fused circuit.

For making pictures of rooms with photoflood lamps use a medium-sized lens opening, such as f:16, to obtain greater depth.

Several lamps, placed in proper positions, will be needed to illuminate all the portion of the room that will be in the picture. The rules of composition that apply to the photography of rooms for daylight apply here also. Be sure that no furniture is near the camera and that more floor than ceiling is showing. A wide-angle lens will get more of the room into the picture, for cameras that permit the use of the short focal length lens.

Flashlight Pictures.—The indoor pictures that we have just discussed can be made even more easily by the use of flash bulbs, though such pictures are more expensive to make, because the flash bulbs can be used only once. One big advantage of the use of the flash bulb is that you can secure a more normal expression on the subject's face than by the use of floodlights. It is difficult to make pictures of small children by means of floodlights because it is so hard for them to keep their eyes open in the glare, and babies will hardly ever open their eyes at all. Another advantage of flash bulbs is that they give so brilliant a light that the camera lens can be stopped down. In this way a much greater depth can be secured. On the other hand, flash bulbs make a picture "flat," because the bulb is usually used at the camera, from which position it throws a flat light full on the side of the subject facing the camera. For indoor flash pictures, at night, the synchronized flash is not needed. The shutter may be opened on bulb or time and closed again after the flash is made. If not using a synchronized-flash device, the flash bulb need not be held right at the camera, but be careful it does not shine or reflect into the lens. Unless using a synchronized flash, do not have other bright lights on in the room or a secondary image will be made while the shutter is open. Test the lighting of the picture by use of an ordinary bulb in a reflector. Hold this in different positions until a pleasing effect is secured, then use the flash bulb held in the same position. Movement on the part of the subject will not spoil the picture, because it is the position shown by the split-second of the flash that will record.

Flash bulbs are made in several sizes, and the exposure depends upon the size of the flash bulb and the distance from bulb to subject.

Use the table given below, which indicates aperture and distance from lamp to subject for medium fast films. The small-sized bulbs can be used up to 8 feet from the subject; the medium-sized bulbs can be used up to 20 feet or a little more; the large bulbs should be used for photos at a greater distance or for photographing large groups. You will have few failures with flash pictures.

Distance (in feet)	Small bulb in metal reflector	Large bulb in metal reflector	Small bulb in ordinary reflector	Large bulb in ordinary reflector
6	f:22	f:32	f:16	f:22
10	f:16	f:22	f:11	f:16
15	f:11	f:16	f:6.3	f:11
20	f:6.3	f:11	f:4.5	f:6.3

For super speed films, use next smaller opening; for slower films, such as Verichrome, use next larger opening.

The above table is designed for foil bulbs used with shutter opened on bulb. For flash gun, use distance-aperture information supplied free by the makers of the synchronized-flash devices, and use shutter speeds as recommended.

Chapter IX

PORTRAITS AND POSED PICTURES

A PORTRAIT is a reproduction of the likeness of an individual, though close-ups of several persons are also called "group portraits." In this chapter a portrait is considered as a picture of an individual. Such pictures are usually made to preserve likenesses, though the most successful portrait photographers are those who have succeeded in preserving a likeness and at the same time flattering the subject. But in general a portrait is just a likeness, though portraits made of individuals for advertising or illustrating purposes may be included in this part of our study of photography.

A posed picture, on the other hand, is one made with special background, make-up and costume, and these pictures are usually made by photographers just for the sake of producing beautiful pictures. The photographer has an idea for a good picture, studies it, prepares the background he wants, secures a suitable model or models, sees to matters of make-up and costume, and then makes the picture. Often he will make a rough sketch of what he has in mind before starting his work.

Home portraits require little special equipment. Besides camera and tripod, you need only one or two lights, preferably on stands, and some sort of reflecting screen. Portrait work does not differ greatly from regular indoor photography by means of floodlights.

Posing the Subject.—The first rule about posing the subject is to attempt to secure a good likeness and at the same time a pleasing effect, with no harsh contrasts. The subject should be turned partly

away from the light to secure the best effect. You can simplify the posing of your model if you will place or arrange the seat beforehand so that the person posing will assume a natural position or the pose you desire for the effect you have in mind.

The pose should be simple, and a full length or three-quarter length can show more of the poser's individuality or character than can a simple bust portrait. The full or three-quarter length is harder to handle, however, because you then have to consider the placing of hands, legs, or even feet.

Proper posing can subdue or correct prominent or irregular features. For example, if the subject has prominent ears so that the portrait, taken from the front, might resemble a loving cup, you can correct this by turning the head just enough so that one ear is out of sight of the camera. If a person has a weak chin or a double chin, the weak chin can be improved and the double chin can be reduced by slightly tilting the head upward. This should be done especially for stout persons, and they should be posed leaning slightly forward but with the head up. In fact, heavy persons often make better portraits if they are photographed standing, because the seated position seems to squat them down too much, making the body, and even the face, appear too round. On the other hand, the slender person is better posed when seated, for the same reasons.

The eyes should be in good focus, and be careful that no extra highlights appear in them. Also, arrange the subject or the lights, or both, so that eyeglasses do not reflect. If you will look at the subject from the position of the camera you can tell if eyeglasses are reflecting light, and the source of the reflection can be found quite easily if you will place your hand in front of the glasses' lens in such a position that the reflection disappears, and then move your hand backward, away from the glasses, to find the light source. The same rule is followed for reflecting or shiny bald heads.

Hands, legs, and feet should not be too far forward, as they might appear distorted in the picture or be out of focus and, consequently, appear blurred.

A last suggestion is to impress the subject or model with con-

fidence, if you can. The subject will pose much better if he or she can feel confidence in you. Do not hurry with your work. Take all the time necessary to pose the subject properly.

Background.—Backgrounds are quite important in portrait work, and should be chosen according to the subject. A subject with light hair or dressed in light-colored clothing should be photographed against a dark background, and a lighter background should be chosen for a subject with dark hair or wearing dark-colored clothing. The figure will then stand out in some contrast to the background; if the background is of the same shade, the figure will merge into it.

See to it that the background does not become more important than the actual portrait. Tapestries make good backgrounds for some types of portraits and so do many printed shawls. The background should be at least 3 feet behind the subject, so that it will not be in sharp focus; it can be left dark or be brightly lighted, depending upon the effect wanted.

Lighting.—Lighting is the most important part of portrait work. There are many possible combinations of lights and the arrangement of a number of lights can become complicated. It is really better to use only one or two lights and to use them well than to try to place more lights and run the risk of placing them improperly. One or two photoflood lamps in ordinary reflectors can give good portrait lighting, though *one* light near the camera will give the subject flat lighting. Newspaper photographers use this type of lighting only because it is the simplest.

The lights must be placed in *some* position, however, and many different effects can be obtained by trying the lights in various positions. If the light shines up from below, it can give a face a rather fierce and terrifying appearance. One *main* light source only should be used so that both highlights and shadows can be seen in the picture. If this light throws a shadow of the subject where it will still be seen in the picture, and the shadow does not improve the picture, a secondary light source can be used to place enough illumination in the shadow to show detail. But it is the main light source that gives the picture its chief and characteristic appearance.

The second light can be used to give roundness. It may be moved toward or away from the subject until an effect of depth or roundness is secured. This light is sometimes called the "modeling" light. A third light may be used to light the background or to give some back lighting, or a back-lighted effect.

Use all of the light necessary to give a fairly short exposure (1/5 to 1/10 sec.), to secure a natural expression, as the subject quickly

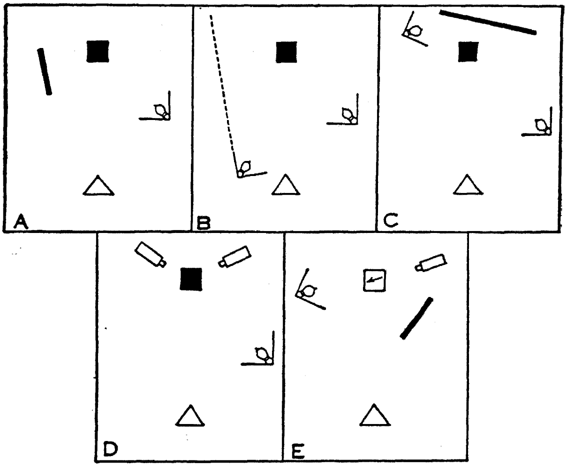


FIG. 29. PORTRAIT LIGHTING DIAGRAMS

becomes tired of the glare. In arranging the subject consider both the angle from which the picture will be taken and the way in which the light will illuminate the figure.

Figure 29-A shows what might be called the standard type of portrait lighting. In this arrangement, one or two lamps shine on the subject from an angle of 45°, and the reflecting screen may or may not be used on the other side. Variation from this standard lighting may be had by use of another lamp placed somewhere on the other side in any position along the dotted line in Fig. 29-B. This is the secondary lamp used to illuminate the shadows and to give certain effects. Figure 29-C shows how an extra light may be

used to illuminate the background. This light may be low or high, and the background itself may be placed on a slant as shown in the figure so that it will receive more even illumination (see Illus. 4).

Figure 29-D shows another use for extra lights. In this case the extra lights are spotlights, used to make halos around the head of the subject, or to give a little detail to hair or back, or to bring out or subdue certain features. One or more spotlights may be used in connection with other lighting, though spotlights are rather expensive pieces of equipment. Figure 29-E shows a more or less standard arrangement for profile portraits. Note that the important light is placed to the left of the subject, and a screen is used on the right side to reflect some light onto the side of the face that will be seen in the picture so that it will not be too dark. The spotlight shown is not important, but may be used to line the hair, for example, and thus improve the picture (see Illus. 5).

The Exposure.—The film used for portrait work should be panchromatic so that all colors, especially shades of color in a subject's face, may register correctly. The focus is important. The camera is close to the subject and usually used at wide or full aperture, so that there is little depth of field. It is best to use a ground-glass type of camera so that the focus can be made sharp. The focus should be made on the eyes to soften the lines of other parts of the face, which gives depth and roundness. With other types of cameras, and without a coupled range finder, it is best to measure the distance from the lens to the subject.

Portraits can be taken with any type of camera, though the single-lens fixed-focus camera requires several seconds of exposure. Only a lens of f:6.3 or faster can make the exposures as short as 1/25 sec. As to the actual length of the exposure, the electric exposure meter is a convenient tool for this type of work, though the exposure table for photoflood lamps given on page 81 can be used. It is better to overexpose than to underexpose.

Posed Pictures.—The chief difference between posed pictures and portraits is that portraits are made to secure or preserve the likeness of an individual or group of individuals and posed pictures are

planned and made to portray or reproduce ideas. In posed pictures the persons posing are usually not attempting to look like themselves, but are, rather, made up and costumed to look like something the photographer has in mind. The subject varies and the models may be made up, and backgrounds, in fact, whole stage settings, may be planned and built to represent some particular type of person in some particular period of history.

These pictures are usually made as a result of an idea, and the backgrounds and stage settings are prepared in accordance. Therefore, they require some study of costuming and furniture of the country and period. Backgrounds may be painted or drawn, but it is more difficult to secure furniture; therefore, the pose of the subjects in the picture will probably have to depend upon what stage-setting material can be obtained (see Illus. 6).

The persons in the picture are models, and models must be chosen with great care in order to get the proper type to represent the particular character for the picture. Also, keep in mind the fact that some persons photograph well and some do not, and that a person's entire appearance may be much different in the photographic reproduction. It might be better not to attempt pictures for which there are no models at hand. So that the picture will be just right, the models will have to be not only properly costumed, but properly made up as well. Now, this subject of make-up is complicated, especially if it involves the use of false hair, such as side whiskers or beards. Make-up for men, for ordinary appearance, is simple, as there is usually no desire to make the subject appear more beautiful. But, since it is a good thing to improve the appearance of a female subject in a posed picture, a few statements about make-up are given in the next section.

Make-up.—Make-up is usually used to improve the appearance of a person's face, but it can make a person look many years younger or many years older, as well. In fact, it can quite change one's appearance. I know of at least one case where a pretty young girl was used as model for a picture of an old man, simply because the photographer found he could secure the expression he wanted more easily

by using the girl as a model than he could with any male model he tried. Make-up can add glamour to a portrait or picture of a girl, and it can be used to correct facial defects. Its use, too, often eliminates the need for "retouching" the negatives.

Make-up for photographic work differs from make-up for stage appearances, because of the fact that colors reproduce quite differently on film from the way they appear to the eye.

Blond persons should have a dark make-up and brunettes should have light make-up, so that the contrast between face and hair, for example, can be strengthened.

Lines and wrinkles can be eliminated by heavy make-up and plenty of light used for the exposure, as the shadows are then blocked out.

All street make-up must be thoroughly removed before the photographic make-up is applied.

The foundation should be grease paint, of a shade selected for the complexion (for portraits) or effect desired. Use sparingly and cover the face and neck evenly.

The lips may be rouged in their natural curves by use of a brush. Take care not to get the color too heavy or they will appear too "made up." Small mouths can be made to look larger and large mouths smaller.

The eyebrows may be darkened and lined a little, using the proper shade of brown or black for the particular complexion or effect desired. For portraits, be careful that the brows do not lose a natural appearance. Faulty brows can spoil a picture.

The eyes may be shaded a little with lining color applied by the fingers over the entire lid and, if the shape of the eye needs it, above the eye as well, fading it out as it nears the eyebrows.

The eyes may be lined with make-up pencil if needed to make small eyes appear larger.

Powder is patted onto the foundation. The powder absorbs the grease in the foundation, and helps to cover all blemishes of the skin, leaving it even in tone.

The make-up may be smoothed out and the extra powder removed by means of a brush.

Brilliantine may be used on the hair, applied with an atomizer.

A little cold cream may be used to make highlights on lips and eyelids or even on the bridge of the nose.

Make-up should be darker for bright lights, and lighter for soft lights.

The foundations and powders should be chosen to match the complexion.

Finishing the Picture.—Posed pictures can be greatly improved during the finishing process—developing, printing, and enlarging. Since many, perhaps most, of these pictures are made for the purpose of exhibition in salons and other shows, a number of different finishing processes are used, among them the paper negative, Bromoil, and Fresson processes. These are discussed in Chapter XIX.

Chapter X

SPECIAL SUBJECTS

THE preceding few chapters have discussed the general rules of picture taking, both indoors and outdoors. These rules can apply to any subject. There are, however, a number of special subjects (mostly outdoors), including both human and other living things and inanimate objects as well. In the next few pages some of these subjects are listed, in alphabetical order, together with certain of the special requirements in each case, in matters of equipment needed, posing of the subject, composition, film, and exposures.

Animals.—Such pictures require much patience. Hunting for the animals is part of the sport, and requires some special knowledge or training of its own. Squirrels can be found in the park almost any day, and they can afford some training in stalking. If you know where you can take wild animal pictures and know how to sneak up on them to do so, the next thing is the necessary equipment. For this type of photography use a rather fast lens, at least f:3.5; the smaller camera (miniature) is really the best because of the depth of field it offers. No other equipment is needed except a tripod, though there may be occasions for the use of a synchronized flash.

Walk slowly through the woods or fields and be on the lookout all of the time, keeping in mind that wild animals usually rest where their natural coloring blends with the surroundings. The instant you sight an animal take a picture of it—you may never get any closer. Then walk slowly forward and take pictures every now

and then. You will have many disappointments, but if you keep at it you will probably secure some excellent animal pictures.

The exposure should be short, probably not longer than 1/75 sec., and much higher speeds are better. The short exposure is necessary because of the fact that the animal will not usually be caught standing still, but on the run. It is best to make such shots at full aperture, partly for the extra speed and partly to keep the background out of focus.

The tripod is of use for making the setup at the edge of an animal burrow or nest. Operate the shutter by means of a long cable release or a string fastened to the trigger; in either case at some distance, so that you can remain hidden. Here, again, only great patience will be rewarded.

Animals which may be found in most woods are the raccoon, opossum, porcupine, skunk, rabbit, woodchuck, and deer. Most persons will not have frequent opportunities to go camera hunting for big game.

Animals at the Zoo.—It is rather difficult to get out into the woods often, at least into woods that contain many animals. But animal pictures can be made at the zoo. You need not worry about the posing or composition of such pictures, and, for outdoor cages, any type of camera will do the job. Use exposure meter or table.

For indoor shots, use large aperture and fast film, and, in dark interiors, use flash bulbs. Go to the zoo on a weekday, when there are fewer people around. Any of the animals are good subjects, but the monkeys are perhaps the best models of all. At least, they are natural posers, and you can secure good action shots, many of them seemingly posed and even composed!

Automobiles.—Pictures of motor vehicles are usually made for advertising purposes, and as a rule are good. You will doubtless not want to spend much time making pictures of automobiles alone, but you may often want to take snaps of friends or relatives posed beside a new car or with a car as the background. The pictures are outdoors, so ordinary exposure meters or exposure tables apply, and any film or camera may be used. A good background for an auto-

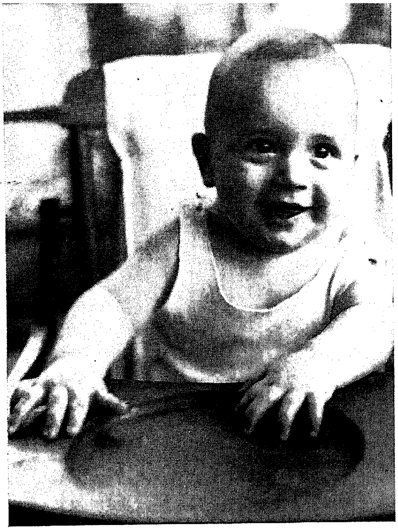
mobile is shrubbery. A car is long and low, so it is a horizontal subject, and should be photographed horizontally, if the entire car is to be included. A person posed beside a car door, however, takes in only part of the car, and can therefore be a vertical subject. Do not get too close to the car or part of it will appear distorted. The shot should be from an angle of about 45°, rather than head on or from one side.

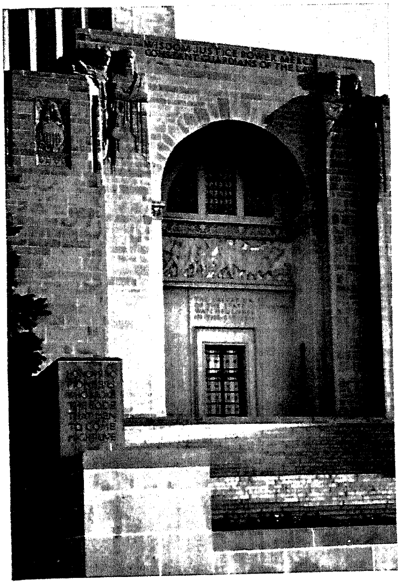
Babies.—These are difficult subjects, especially indoors. Outdoors, the chief problem is to get close enough and still secure a sharp focus and short exposure (see Illus. 7). Indoors, it is hard to get a young baby to face the brilliant light, so flash pictures are preferable here. Babies over a year old can usually work for short lengths of time under floodlights. Use two lights, one on each side, and use a camera with at least an f:6.3 lens, so that the exposure can be fairly short. If possible, secure enough light so that the exposure can be 1/25 sec. or faster, so that a tripod need not be used. The advantage in holding the camera in the hands is that you can move about quite freely, to secure the particular angle that is best. Watch out for focus, however, if you are moving about, and remember that the baby will also be moving.

Don't try to pose a baby. It can't be done. Besides, he will pose himself, and go through a great variety of different and good poses in as many seconds. Give him some toys to play with and wait until he becomes interested in one of them before shooting. Also, after turning on the lights, give him a moment or two to become accustomed to the illumination.

Shoot at close range and include little background. Use panchromatic film and lots of it. Take a great many shots, in order to capture those fleeting expressions; most of them will be good. Great patience is required in this type of photography, to secure the desired effects.

Birds.—All sorts of birds, at rest or on the wing, are good subjects for photography. Such pictures can be taken at any season, in parks or in the field, by means of remote control with camera on a tripod, or rapid shots of birds on the wing, by means of a telephoto lens





7. (*Upper Left*). J. *Kodak Recomar, Verichrome film pack, 1/15 sec., f:5.6.*
Photograph by George Holmes.
8. (*Upper Right*). THREE WISE FOOLS.
Leica Camera, Ultra Speed Pan film, 1/100 sec., f:4.
Photograph by Claude Pilger.
9. (*Lower Left*). NEBRASKA CAPITOL.
Leica Camera, Supreme film, 35 mm. lens, Leitz No. 2 filter, 1/40 sec., f:9.
10. (*Lower Right*). JANICE. *Kodak Recomar, Portrait Pan cut film, 1/15 sec., f:6.3.*

11. CLOUDS. *Photograph by Claude Pilger.*
Leica Camera, Supreme film, 1/50 sec., f:9, A filter.
12. FLOWERS. *Photograph by Claude Pilger.*
Voigtlander Camera, Superpan pack, 1/2 sec., f:16, K-3 filter.

or attachment. There is no problem of composition in either case, and when shooting "on the wing" you can pay little attention to focus. You will not often be nearer than the infinity or 100-foot position anyway. The exposure will have to be short, at least 1/100 sec. If possible, use sky or water for a background, so that the necessary contrast can be secured (see Illus. 8).

Photography of bird life can be done in your own back yard. For this purpose you need some "bait." Bits of suet may be fastened to the limbs of trees, or seed or crumbs placed on platforms mounted on poles or on outside window ledges. The camera can be mounted in proper position, focused for the "lunch counter," and operated by remote control with a thread fastened to the trigger. Use a speed fast enough to stop motion, perhaps 1/100 sec. In shooting birds in flight, follow them by means of direct view finder or framer, and shoot at speeds regulated by the distance to the birds. The nearer the subject the faster the exposure must be.

You will not have too many successes at first; bird photography is difficult. But if you will spend the necessary time training the birds to come to the lunch counter, whether in the back yard, in the woods, or at the lakeshore, you will get pictures.

Buildings.—The general rules for outdoor photography apply to the photography of buildings, especially with regard to focus and exposure. Remember to keep the camera level, otherwise the building will seem to be leaning backward. The most important thing to remember, to make good pictures, is to have some object in the foreground so that the building may be viewed through a sort of vista. The foreground object gives the picture more depth. It is best to use small aperture to secure depth; since the smaller aperture requires a longer exposure, it is best to use a tripod. If there are interesting clouds, these can be captured by use of a K2, G, or A filter. The filter, of course, increases the length of the exposure (see Illus. 9).

Early in the morning or late in the afternoon, on sunny days, is better for picturetaking than when the sun is high, as the shadows are longer at these times, thus adding to the beauty of the picture.

However, select the best time of day for the particular building to be photographed and the most attractive angle. Horizontal subjects should be treated in horizontal pictures and vertical subjects in vertical pictures. Most building pictures are vertical, unless the foreground object, for example, the limb of a tree, should require the horizontal composition.

Another good idea, used to give the viewer the correct impression of respective sizes, is to have one or several persons in the picture, but not close enough to the camera to detract from your main subject. Parts of buildings (or architectural details) are also good subjects.

Children.—Pictures of children can be more than just snapshots, but some special attention will have to be given to this type of subject. The pictures may be taken indoors (see Chapter VIII) or outdoors (see Chapter VII), and the rules should be followed as given in those chapters. It is a good thing to keep a picture history or story of the growth of a child, and many parents do this. These pictures may as well be interesting as not, and the best way to make them interesting is to have them unposed. As in the case of babies, small children may be photographed much better when playing with some favorite toys or books, and especially with pets. Hold the camera, or have it on a tripod, fairly low. If, to secure a definite viewpoint or angle, you have to tilt the camera downward, be sure that there are no vertical lines in any objects in the picture or they will then seem to converge, and will spoil the picture. Then too, from a low position the child's face can be seen much better (see Illus. 10).

Select good backgrounds that will contrast with the subject. Have the light coming from the side so that the child will not have to squint. The subject should be doing something to secure "action" pictures. Use panchromatic film and fairly fast shutter speed, about 1/100 sec. if possible.

Children's Portraits.—Though everything mentioned about portrait photography in Chapter IX holds true for children, there are a few special instructions for making portraits of children. These are

better made indoors, with either photofloods or flash bulbs. Avoid trying to pose the child. It is better to take his picture doing something he likes to do, or does every day, in his own familiar surrounding. If he does not want his picture taken at all, wait until some other day. Use plenty of film, when things are going all right, but none at all when they are not.

Clouds.—This type of subject has been mentioned on page 67. Remember that the clouds will photograph white and so will the sky, if taken on ordinary film and without a filter. Use panchromatic film and a filter which absorbs some of the blue light, such as the K2 filter. Focus for infinity.

The special sky filter, which has one-half yellow and the other half clear, may be used to record clouds, without increasing the exposure. The cloud part of the scene being photographed is recorded through the yellow part of the filter, and although this cuts down the exposure, it does not matter. The K2 filter, being all yellow, gives some color correction for the landscape as well as the sky, though it cannot be used very well on cameras not equipped for much variation in length of exposure. The red filter gives the greatest contrast to cloud pictures, and furnishes a pictorial effect (see Illus. 11).

As we have said before, if there are no clouds in the sky when you are photographing a good landscape, they can be "printed in" in the darkroom, as discussed in Chapter XVII.

Fires.—Pictures of buildings on fire, made in the daytime, are interesting, but night pictures are much more so. The flames make a brilliant outline against the black sky, and smoke appears in silhouette against the brighter background of flames. Because red is the chief color of the fire, use panchromatic film. Use tripod and give several seconds' exposure at wide aperture. With a box camera, use the largest stop.

Fireworks.—Pictures of fireworks are easy to make. The important thing is to place the camera on a tripod or other firm support. Point the camera in the direction of the fireworks, open the shutter on time, and keep it open during the explosion or the flash and then close it. It is best to have no other lights around. Use a medium

aperture, about f:8, unless the lights are too far away, in which case use full aperture. A rocket exploding records on the film in streamers of light, making beautiful, graceful lines. Several effects can be taken on one film. A foreground scene, such as a lake, or group of figures, adds interest to the picture, though these foregrounds will probably have to be included in the picture by means of double printing.

Flowers.—Pictures of flowers may be taken indoors or out, though the indoor ones will be of flowers in pots or cut flowers in vases. A picture of an entire flower bed is confusing to the eye. It is better to take pictures of single blossoms or single stalks of flowers. In order to do this shoot from close range. With cameras that do not have sufficient bellows extension to permit focusing at 2 or 3 feet, or even closer, the special portrait attachment, which slips over the regular lens, can be used.

The best pictures of flowers are probably made by ground-glass focusing cameras or those with coupled range finder. Use a medium aperture to secure the necessary depth of field; speed is not important. Pictures can be taken at from 1/10 to 1 sec. (see Illus. 12).

Flowers have many colors, and all colors will not register accurately on the film. So flower pictures should always be taken on panchromatic film; if the flowers are yellow (such as daffodils), use a K2 filter. For computing the exposure use a meter or the outdoor exposure table.

Lighting is quite important. Some shadows are needed to outline petals or blossoms. Outdoors, with natural lighting, it is best to take flower pictures either early or late in the day, when the light is from the side. If the day is hazy, or if the sun is under light clouds, conditions are excellent for flower photography. The blossoms will turn toward the sun, so set the camera accordingly, and keep it low, to view the flowers from the side rather than from above. Wind is a natural enemy of flower photographers. To avoid motion caused by the breeze, place a screen of cardboard or other material around the flower stalk being photographed. At least one photographer ties the stalk with thread to prevent motion or to place it in a special position. Indoors, flowers may be lighted by

photoflood, or good flower pictures may be taken by the use of flash bulbs. For cut flowers in a vase notice which side shows the best arrangement and plan the lighting accordingly. Backgrounds may be of paper or cloth of a light color, perhaps tan. The background must be smooth, because it will not be far enough from the flowers to be out of focus.

Furniture and Tapestry.—Furniture photographed on ordinary film will not show the grain of the wood. In a *good* picture of a beautiful piece of furniture, however, the grain should show. The piece of furniture may be "posed" before the camera with suitable background (which should offer some contrast) and photographed on a panchromatic film under photoflood light. To secure the grain, use a red filter (A), for dark finish such as mahogany, or a yellow filter (K2), for yellow wood such as oak.

Tapestries and carpets are best photographed with the A filter if they contain much red, yellow, and blue. If green is the predominant color, use a green filter. In either case the filter lightens light colors and darkens dark colors, thus giving contrast between two colors that would otherwise record as nearly the same shade.

Lightning.—Make pictures of lightning flashes in the same way that fireworks shots are made. Focus the camera at infinity, place it on a firm support, aimed in the direction where good flashes have been seen. Open shutter on "time," with full aperture, and close shutter again after the flash, or after several flashes (see Illus. 13).

Mountains.—These are the largest subjects you will ever have, and the photograph should make them seem large. This can be done by having a figure in the picture, but not so close to the camera as to withdraw attention from the principal object. Also, it is better to take a picture of a single peak rather than a whole range of mountains, and frame it between two trees in the foreground, or under a spreading branch of a tree. The rule of having the light come from one side applies here, too. There is no other way to secure the shadows that give depth and form to the picture.

Many photographers have thought that a small aperture is the best for taking mountain pictures, but a medium stop, such as f:8,

gives a better impression of great distance. Use exposure meter or exposure table, panchromatic film, and K2 or A filter if cloud formations are wanted or can improve the picture (see Illus. 14).

Movies.—Pictures of either stage or screen can be taken with a fairly fast lens, and by use of the new ultra rapid films, such as Superpan Press or Super Panchro-Press. With f:2.8 or f:2 lens, with diaphragm wide open, an exposure of 1/10 sec. can be used for "still" subjects, that is, subjects on stage or screen not moving rapidly. Film revolves at about three frames in 1/10 sec., so the picture will really be made *of* three frames of film, and this will give a double exposure in case the scene changes abruptly. Close-ups and scenes in which the figure remains fairly quiet are the best. Faster action can sometimes be recorded by faster shutter, though the screen must be fairly bright at the time or underexposure will result. Stage shots can be taken at f:3.5 or f:2.8 at speeds of 1/25 or 1/50 sec., as stages are usually quite well lighted.

Pets.—Pets are good properties to use in posing children, and they make good pictures by themselves. This type of photography differs from wild animal photography at least in the fact that the game doesn't have to be stalked.

There is a series of little books, made up of pictures of dogs, kittens, and rabbits, in which these pets are placed in all sorts of poses, and even costumed. But this type of pet photography is best left to expert animal trainers, as it requires not only many hours of tedious and painstaking labor, but requires special training as well. Pictures of pet dogs, cats, or rabbits can, however, be secured with little trouble (see frontispiece). Pets differ from human beings in one important respect—they do not try to pose, or they are natural posers.

Place the pet on table, chair, or floor. Let him assume whatever position he wishes. Then take a lot of shots, to ensure the catching of a good pose. Two flood lamps, fairly near, supply the needed light, or flash bulbs may be used. When ready to shoot, snap the fingers or whistle to make him look up. Then shoot quickly. Use tripod and panchromatic film, and select the background to contrast

with the subject. The background itself may be small screens or even pieces of cardboard of different shades. The camera should be on a level with the animal's head, neither above nor below (see Illus. 15).

In using floodlights, set one lamp on one side and one on the other, placing one farther away. Both should be a little higher than the subject. Use exposure meter or table of exposures for flood lamps. If using flash bulbs, use one small bulb at about 6 feet and stop the camera down to f:11 or f:16, depending upon whether the subject is dark or light. Use table of exposures for flash bulbs, page 83.

Keep in mind the natural expressions of dogs and the natural positions of their ears. For example, Boston terriers, great Danes, and police dogs should have their ears erect, and attracting their attention suddenly will do the trick. Cats make better pictures in partial profile, as a rule. Rabbits and guinea pigs are difficult to pose, and usually cannot be photographed on chairs or tables as they will not remain there. Sometimes good pictures of these pets can be made on the lawn, especially if caught while eating.

Rain.—Yes, good pictures can be made in the rain! The chief thing to remember is to use a hood to keep the lens dry and a cover for the camera. Orthochromatic film is better than panchromatic for rain pictures because it gives more contrast. If the rain is too heavy, a yellow filter will help to penetrate it. Good rain pictures can be made from indoors, through a window speckled with rain. For these, stop down enough to get depth into the background.

Reflections.—These are good subjects for photography though they must be handled with some care. Reflections on water, of clouds, trees, or buildings may be photographed the same as any other outdoor subject, the principal difference being that the exposure will have to be made long enough to secure the image on the reflecting surface. Reflections in mirrors involve a little different procedure. The focus should be made for the reflected image, that is, by adding the distance from mirror to subject to the distance from mirror to camera. If the camera is 6 feet from the mirror, and the subject is 4 feet, the focus must be set for 10 feet. To include the subject

itself, as well as the reflection, the focus should be set only for the distance from the mirror to the camera. Use fairly small aperture to secure better depth of field.

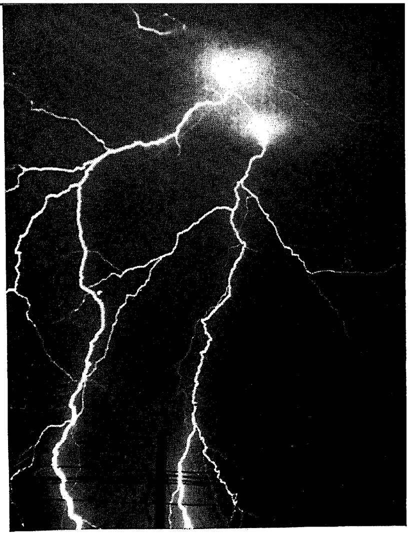
Snow.—Here is a fascinating field for picture takers—though a cold one. Landscapes are usually better than street scenes, and the pictures should be made as soon after a snowfall as possible, to preserve the "freshly fallen" effect. Also, heavy frost on tree limbs can become the subject for beautiful photographs.

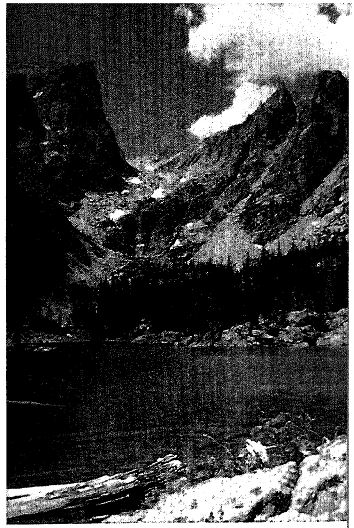
Any camera will do, lens f:6.3 or faster being better, though speed is not essential as plenty of light is reflected from white snow. When the camera is taken outdoors vapor will condense on the warm lens, and this must be wiped off before taking pictures. The same thing happens when a cold camera is taken indoors. Leave the camera open for a time so that it can dry. The shutter works a little more slowly when cold, but you can compensate for this by setting for a little shorter exposure.

Watch the composition just as in taking regular summertime landscape pictures. Foreground objects help to give depth; clouds make a sky more pleasing; human figures give contrast and lend the intimate touch. A yellow filter helps to record detail. Most sheets of snow will contain small irregularities, perhaps holes, animal tracks, or other breaks. These will all have shadows, and the shadows are blue, so that they will photograph the same as white unless a yellow filter is used to absorb some of the blue light. A lens hood will help to keep reflected light out of the lens.

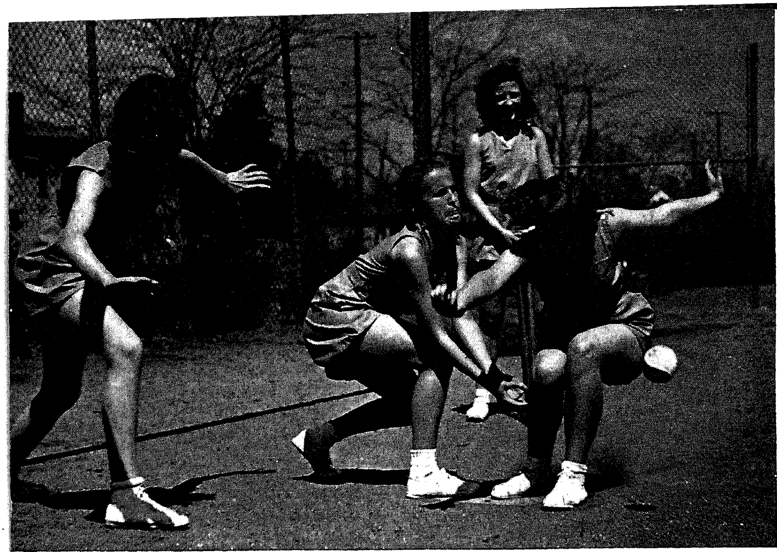
The exposure does not differ much from the usual summer exposure. Use meter or exposure table, and use smaller stop for more distant views. Panchromatic film is not essential in snow photography; an ordinary orthochromatic film will give about as good results, unless you are including in the picture a number of persons in brilliantly colored clothing. Some photographers, however, recommend the panchromatic type of film for nearly every type of subject, and include snow scenes in the list chiefly because, late in the day, there is so much yellow light.

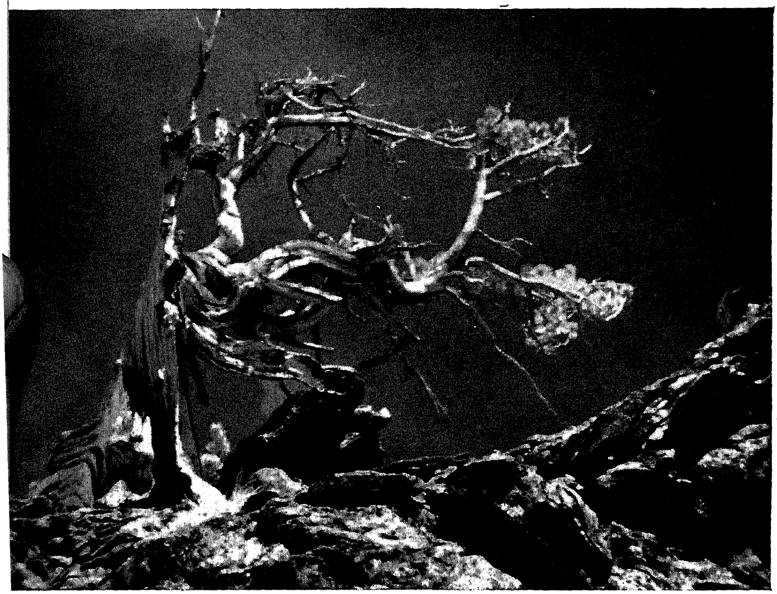
Pictures of persons skiing, sleighing, snowshoeing, or skating are





13. (*Upper Left*). LIGHTNING. *Photograph by Claude Pilge*
Voigtlander Camera, Superpan pack, f:11, bulb until flash.
14. (*Upper Right*). DREAM LAKE. *Kodak Recomar, Panatomic pack, 1/5 sec f:22, K-2 filter.*
15. (*Below*). KITTENS. *Photograph by Claude Pilge*
Voigtlander Camera, Superpan pack, flash at f:11.





ↄ. BASEBALL: ACTION PICTURE. *Photograph by H. A. Coleman.*
eica Camera, Supreme film, 1/1000 sec., f:3.2.
ↄ. DEFIANCE. *Photograph by Claude Pilger.*
eica Camera, Infrared film, Leitz No. 1 red filter, 1/40 sec., f:2.

also fun to take. They require shorter exposure to stop the action, of course, but with so much light—sunshine on bright, gleaming snow—it is easier to get a short exposure.

Spiderwebs.—Good webs are hard to find, and even harder to photograph in their natural settings. But small webs can be brought into the house, by breaking off the branches of trees or shrubs to which they are attached, and can then be photographed against dark backgrounds by use of one or two floodlights. Ground-glass focusing cameras are best for this work so that a sharp focus at close quarters can be had. Spray the web with clean water in a small spray gun, and *gently* so that the pressure will not break the strands. This gives the effect of dewdrops, and the web so prepared must be photographed immediately, before the drops dry off. Use small stop and long exposure for best results.

You can't get spider webs outdoors in the daylight at all, and at night a long exposure cannot be used because of movement of the strands of the web. The slightest breeze will spoil the picture. A flash picture of a dewy web against a black background, such as the sky, is possible but rather difficult, as all conditions must be just right.

Sports.—Any sport is a subject for picturetaking, but not just any camera can get sports pictures. You need a camera with fast shutter speeds, as the photographer must "stop" action in mid-air (see Illus. 16). For sports shots indoors—for example, at a basketball game—you will need a synchronized flash. Use lens shade most of the time, and load with fast panchromatic film. Exposures may be made at wide or full aperture, if the focus is correct; the background is not so important. The chief thing is to secure genuine action shots; a tripod is seldom used.

The exposure must be short, and calculated in advance. An electric exposure meter is a handy accessory for this type of picture work, though an extinction type meter may be used. Times will vary greatly. Normally moving objects at a distance of 40 feet or beyond may be stopped at 1/50 sec.; closer shots require 1/100 sec. For stopping broad jumpers, pole vaulters, divers, runners, etc., a

speed of 1/300 to 1/500 sec. is needed, depending on distance to the subject. An automobile race can be stopped by a fast focal plane shutter at 1/1000 sec. If using a Leica, hold the camera normally for objects moving from right to left, and hold it upside down for objects moving from left to right, so that the shutter will be moving in the same direction as the object being photographed. With any camera, at fast shutter speed, it helps to stop the motion by swinging the camera in the direction of the motion. Experience will be the best guide in determining what exposure to give. Indoors, a large flash bulb at fairly close range can give a short enough exposure to stop motion, if used with synchronized flash.

Statues.—Outdoor statues are best posed against the sky, and are nearly always photographed better from below. Wait for the proper time of day, so that the sunlight makes good shadows. It is sometimes well to shoot into the sun, and in such cases the side of the statue facing the camera can be illuminated by flash. Pictures of statues are much better if taken from new or unusual angles, different from those seen by the eye of the casual observer. Use normal exposure or slightly underexpose so as to give the shadows a more dramatic effect. White stone statues can be made to stand out in relief against the sky or other light background by using a red filter.

Street Scenes.—Street scenes are not so pictorial as they are story-telling. Almost any normally busy street of a city is a good subject. Try to keep the passers-by, or children playing in the street, from looking at the camera. What is preferred is an action picture. The exposure for these action pictures will have to be short enough to stop the action. Better shots can be made by having the camera a little higher, as from the steps of a building. If standing on the street or sidewalk hold the camera as high as you can.

Trains.—Pictures of trains should ordinarily be horizontal. However, a close-up at short range, as the front of a locomotive, may be vertical. The shots can be varied from distant views of whole trains to close, detailed pictures of a single great driving wheel; and unusual effects can be obtained by novel angle shots.

For these and other pictures of trains not in motion, use tripod and small aperture. The yellow filter will give much more detail. Since the subject is black, orthochromatic film is as good as any, and really gives greater contrast. For moving trains you will need a fast shutter speed, above 1/100 sec. at rather wide aperture. Take a moving train at an angle, and use faster exposure in proportion to the speed of the train.

Trees.—Though trees are probably the most important part of general pictorial photography, they may be taken singly and used as subjects for what is really portrait work. Trees have great individuality as well as beauty—some are gnarled and weather-beaten (see Illus. 17); others, like the spruces, are young and vigorous. There are all sorts of possibilities. You can make beautiful lacy pictures of trees in winter or you can take a picture of a beautiful mass of foliage, symmetrical in form, and outlined against a blue sky broken by fleecy clouds.

The exposure is of the normal outdoor type, and the lighting is of great importance. Use a light source from the side or even from the back.

Window Displays.—Department store owners often have pictures taken of their show windows, and we mention this type of photographic subject because of the difficulty in photographing through the glass windows. Such pictures should be taken at night with camera on a tripod, and exposure calculated by the use of a meter of some sort. The focus must be sharp, and the picture can be taken from a closer position if a wide-angle lens is used, though the use of the wide-angle lens requires ground-glass focusing or coupled range finder. Be careful that reflections from store lights or signs across the street do not interfere. Use panchromatic film and medium aperture.

In the daytime it is nearly impossible to take pictures of window displays because of the many reflections in the glass. By means of a polarizing filter these reflections may be subdued or even eliminated, thus permitting window displays to become daylight subjects. The use of the polarizing filter will be explained in the next chapter.

Water.—Pictures of water are better if a sparkle can be caught, and this depends upon having both wind and sunlight just right. The shots should be made at a rather close range from the shore of a lake or river, from beaches, piers, or even from bridges, and need a sunny day with a breeze. To get the most sparkle, shoot directly into the sun. To avoid having the sun in the picture, and to shield the lens, shoot downward from a slight elevation.

A meter will help determine the proper exposure, which needs to be fairly short (perhaps 1/50 sec.), to stop the ripple or sparkle. At the same time, the aperture should be at least medium, to give sufficient depth. The meter is inclined to overread, because of the bright highlights, so the indicated exposure may be increased by at least twice. As in the case of the photography of rooms, include more foreground (water) than sky so that the picture will not be top-heavy. Some object, a passing boat, a reef, or even a bit of driftwood in the foreground, will help the effect.

Chapter XI

SPECIAL METHODS OF PICTURETAKING

The preceding chapter discussed pictures of a number of special subjects for photography. Any kind of camera can be used for most of these special subjects, and the picturetaking work differs only in arrangement of subject, position of camera, exposure, and so on. There are, too, different *ways* in which pictures are made, with subjects differing widely, in accordance with the limitations of each *type* of picturemaking. The position of the camera and other factors remain nearly the same for each picturetaking method.

COLOR PICTURES

For nearly a hundred years film has reproduced images in black and white and in-between shades of gray. Consequently, prints made from negatives have also been in tones and shades of gray. Now, however, it is possible to make color pictures *on film*, in almost any camera. These pictures have to be made on special color film, such as Kodachrome or Dufaycolor, and the resulting images are not negatives, as in the case of ordinary film, but are actually positive images.

These images must be viewed by the use of a projecting machine, which casts enlarged images onto a screen; or by looking at the film positives, or transparencies, by placing them on a glass lighted from beneath. In either case, the images are viewed by light passing *through* them, or *transmitted light*. Pictures on paper are viewed by

means of light reflected from the surface, with the light shining *on* them rather than *through* them.

The images on color film are positives and not negatives. This is simply because the images have been *reversed* in development, and the reversal has been made to permit the transparencies to be viewed as the photographer saw the original object. This is because no simple method, so far, has come into general use whereby straight contact or projection prints, also in color, can be made from color film. When such a process comes into general use the film may be left as a negative.

Kodachrome Color Film.—It is advisable to know something about the way color film works before using it in the camera. The

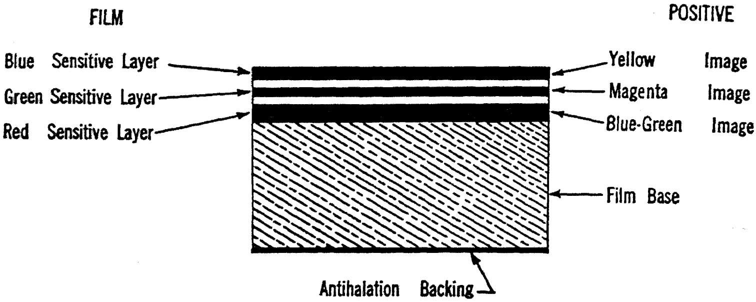


FIG. 30. KODACHROME DIAGRAM

Eastman Kodachrome is made up of three emulsion layers, on top of one another on the film base, with thin layers of gelatin between them. The layer next to the base is made sensitive to red light and becomes, upon development and reversal, the blue-green image (see Fig. 30); the second layer is the green sensitive emulsion, which becomes the magenta image; the third, or top layer, is the blue sensitive portion, which becomes the yellow image. When you look at the positive picture on the film, by means of transmitted light, either on top of a lighted glass or by means of a projector, the three colored images blend together, as the eye sees them, into one image in all the colors shown by the subject photographed.

You can develop your own ordinary film yourself, as explained

in Chapter XIII, but Kodachrome is so complicated that it must be processed by the factory. This processing includes several steps. First, the exposed color film is developed into a negative. This negative is then bleached out and the film is again exposed to light and redeveloped in blue-green special developer. Then a second bleach destroys the blue-green image in the two upper layers, after which the film is again exposed to light and redeveloped in the red developer. A third bleach destroys the red image in the top layer, the film is exposed to light, and the top layer is redeveloped with the yellow developer. When all the silver has been removed from all the dyed layers, the result is the positive image in full colors and without silver grain.

Dufaycolor Film.—This film does much the same thing as Kodachrome, but in a different way. The color is obtained by means of a

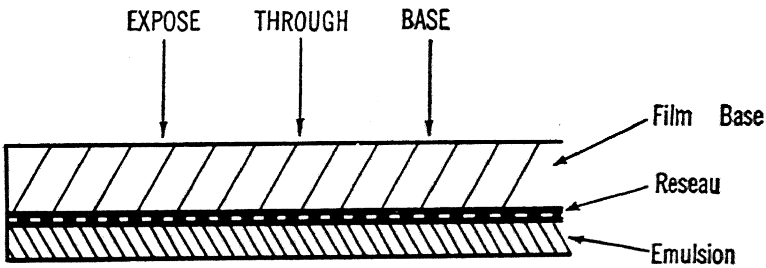


Fig. 31. Dufaycolor Diagram

color filter screen called a "reseau" placed between the film base and the light-sensitive emulsion. This reseau is composed of tiny mingled areas of different colors—blue, green, and red—areas so small that there are 1,000,000 to every square inch of film. Being so small, they are invisible as separate areas and the colors are produced for the human eye simply by confusion. Figure 31 shows a cross section of Dufaycolor film. The film is exposed *through* the base, so that the light must pass through the reseau before reaching the emulsion.

In processing, Dufaycolor is developed into a negative image,

bleached, reexposed to light and redeveloped. As this is development by reversal, the resulting image is positive and not negative. You can process Dufaycolor in your own darkroom (see Laboratory Manual).

On Kodachrome film, light of a particular color or shade entering the camera registers only on the emulsion layer made sensitive to that particular color. On Dufaycolor film, the light registers on the one emulsion, but only after having passed through the reseau, which, being made up of blue, green, and red, filters the light, so that the blue rays register only under the blue parts of the reseau, and so on.

Taking Color Pictures Outdoors.—Photography has been spoken of as "painting with light." This is true for ordinary black-and-white photography, because all different colors must be recorded as shades of gray, and shadows and highlights are the most important parts of the picture. With color, everything is different. Shadows and highlights are not so important, but color is everything. All colors and shades register as the eye sees them, and composition is made by arranging colors harmoniously and in good balance. The first rule is: Do not select subjects that contain too many brilliant colors or color contrasts. Keep the color scheme as simple as possible, and without scattering the colors too much. Have one color predominate, and this color should be in keeping with the general thought of the picture (if any).

No special equipment is needed for making pictures in color. Color film can be used in any camera employing the sizes in which color film is available. Kodachrome is available in various cut-film sizes and in 35 mm. and Bantam rolls. Dufaycolor is available in cut film and several size rolls as well. The films are both slow, both having a Weston speed of 8 for daylight, 3 (used with filter) for artificial light. The exposure is the most important part of color photography, because color film does not have the latitude of black-and-white films. Consequently, a good exposure meter is valuable for this work, though the film comes packed with exposure tables and instructions. The easiest use of color film is with flat lighting, in which the light comes from behind the position of the camera.

This is true because shadows and light contrasts are not important, the pattern of the subject being shown by the color itself. In black-and-white photography, of course, best results are had with side lighting to give contrast between black and white.

Indoor Color Pictures.—Kodachrome is made in three types: regular, for use in daylight; Kodachrome A, made in 35 mm. size, for use under photoflood or photoflash light; and Kodachrome B (professional), for use under Tungsten. Kodachrome type A, made for photoflood light, can be used in daylight with a special filter, when it has the same Weston speed rating of 8. Kodachrome A has a photoflood speed of 12, so that it is much better for indoor work than the regular type used with a filter. Dufaycolor, used indoors, must have special filters, and the filters are specially made for the film itself.

For indoor pictures, with either color film, it is best to use flat lighting, and an exposure meter is helpful. Avoid shadows in indoor work the same as in outdoor. The make-up for color photography is quite different from the usual photographic make-up. Ordinary street make-up is best.

COPY WORK

Copy work includes making photographic reproductions or copies of other materials, printed, handwritten, painted, or photographic, in various sizes on flat surfaces.

This photographic method is used for making reproductions of paintings. Another branch of copy work includes the photographing of old newspapers and books, page by page (microfilming), partly because the originals themselves are rapidly deteriorating and partly to make the information they contain available to many persons. This type of copy work is usually done on miniature size (35 mm.) film. Then, there are the many commercial and advertising uses for copy work; for example, the photographing of the labels and package designs used on products, so that the photographic copies can be used in advertisements.

Still another branch of this work includes the copying of photo-

graphs. Sometimes the original negatives have been lost, and it is desired to reproduce the original pictures (usually portraits) so that a number of persons may have copies. There is also the matter of the restoration of old pictures that are torn, badly soiled, or stained.

Equipment for Copy Work.—Equipment for copy work must include an easel or some flat surface for mounting the material to be copied. There must be some arrangement for throwing light on the subject, and a place for the camera. A good copy table includes a long beam of wood with a large board of about 24 x 36 in. mounted vertically at one end. This board is the easel on which material to be copied can be pinned, fastened with thumbtacks, or clamped under glass. A platform, rising from the beam, holds the camera, and this platform can be raised or lowered and slid along the beam so that the camera can be placed at different distances from the easel. About three feet in front of the easel is a cross arm, 6 feet long; on the ends of this arm are placed lights in reflectors so that they shine directly upon the easel. The beam itself is mounted on a sort of sawhorse with legs about 4 feet high, and the beam is hinged so that it can be tipped into vertical position, permitting objects to be photographed lying flat on the easel. In the latter position this type of photography is not copy work, but is, rather, still-life photography, as discussed on page 128.

Making Copies.—The several types of subjects for copy work present special problems. In any case, the focus must be sharp, and this may best be brought about with a ground-glass focusing camera and the use of a hand lens in addition. Cameras not equipped with ground glass but with accurate coupled range finder may be used with good success though they cannot be brought so close to the subject without special equipment for focusing.

Oil paintings and other colored pictures can be photographed on films adapted to the colors of the original. For example, a picture containing several light colors, which would photograph darker on panchromatic film, may be taken on orthochromatic film, which will make the light colors lighter and the dark colors darker, thus giving contrast. Pictures which include reds and darker colors should be

taken on panchromatic film. The lights must be placed at such an angle and such height that they do not throw reflections into the lens. Often it is advisable to use one light only, though this practice makes one side of the picture darker than the other because it is farther from the light. An exposure meter can be used for this work, or you can, with a little practice, work out an exposure table for artificial light, because the light source and the intensity of the light remain constant. Illustration 18 is an example of a copy of a colored surface.

Another method of photographing oil paintings, which have rough and glistening surfaces, is to use a polarizing filter. These filters are discussed below, page 121. For photographing paintings, some photographers recommend the use of color filters over the lens, though others do not.

For photographing black-and-white pictures you can use orthochromatic film, which requires a longer exposure (stop down to f:32), but gives better rendering of the originals. A K2 filter may be used for this work with good success, too.

Copying Newspapers and Printed Pages.—For copying the pages of print there are specially designed miniature cameras, usually mounted on stands so that they shoot down on the book or newspaper page from above, and click off the pages rather rapidly. These tiny films may then be viewed by projection onto large flat surfaces. Special cabinets have been built for the use of students reading newspapers that have been recorded on film. One of these, called the Recordak, projects the image onto a surface which slants upward a trifle to make the reading easier. It shows a little over one-fourth of a page at a time, and on the side of the cabinet there is a lever by means of which other portions of the page can be brought into the field of view.

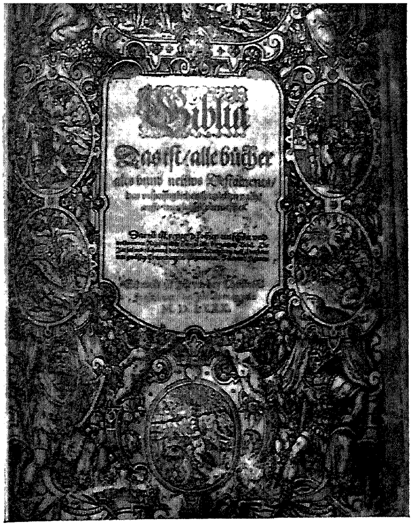
A knowledge of the field of photography is not complete without a brief survey of this type of work. You may sometime want to copy a single page or a few pages out of a book. This can be done on the copy table, whether the table is arranged for horizontal photography, as the one described, or to photograph vertically onto a

subject lying on the table. In either case clamp the book open in the position wanted. For books of normal size, the kind of copy table described is the best, because a little shelf can be built to fasten onto the easel on which the book can be placed open at an angle of only 90°. The part of the book containing the page to be photographed can be flattened by clamping it to the easel under glass, and the other part of the book can be clamped down to the protruding shelf.

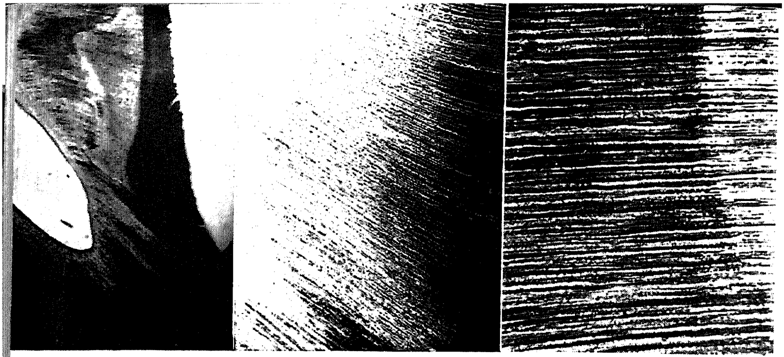
For copying printed material or line drawings in black and white, you need all the contrast possible. The Eastman Kodalith film, or the Agfa Reprolith or Minipan (35 mm.) films are built specially for this type of work. They are slow films (Weston rating 5 for daylight, 12 for artificial light) and require a long exposure. The Weston meter, however, when set for these slow emulsion speeds and using the 0 position of the calculating dial, gives the proper exposure *in minutes*. The focus must be sharp, as for other types of copy work.

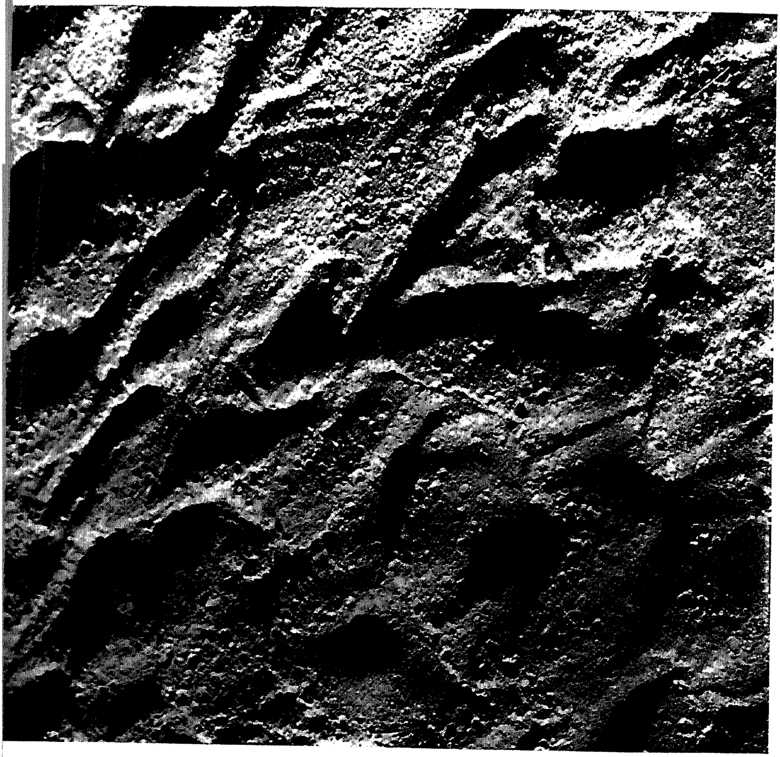
Use of Filters in Copy Work.—In copy work color filters really come into their own, especially those called "contrast" filters, which are chiefly the reds and oranges, though any color may be used on occasion. To photograph a piece of colored printed material that includes red, green, and blue, an ordinary film will reproduce the blue much lighter and the green and red too dark. A panchromatic film will not give the truest rendering without a filter, and a red, green, or blue filter would photograph the same colors much too light. The best filter for correcting these colors is the yellow (K2) filter. Since it is used for correcting colors it is spoken of as an "orthochromatic filter."

Colored stains on photographs or documents may be eliminated from the copy by using filters of the same color as the stain. For example, for a photograph with a green stain use the X1 filter, which is a light green. If there is still some of the green stain apparent, use a deeper green filter such as the X2. The same procedure can be followed for stains of other colors, by selecting the filter of the same color. If the stain is on a black-and-white line drawing or a



18. (*Upper Left*). COPY OF COLORED BIBLE COVER. *Photograph by Claude Pilger.*
Voigtlander Camera, Superpan pack, 6 sec., f:16, daylight, G filter.
19. (*Upper Right*). PHOTOMACROGRAPH. *Photograph by Claude Pilger.*
Voigtlander Camera, Superpan pack, 2 sec., f:22, photoflood; 2x enlargement on negative.
20. (*Below*). INFRARED PICTURE. *Photograph by Claude Pilger.*
Leica Camera, Infrared film, 1/5 sec., f:6.3, Leitz No. 1 red filter.





21. (*Above*). Photomicrograph of Tooth Section. *Left: 20x magnification; Center: 100x magnification; Right: 500x magnification.*

22. (*Below*). Sand: Texture Picture. *Photograph by Claude Pilger.*
Leica Camera, Supreme film, 1/40 sec., f:6.3, green filter.

piece of printed material, you may still use the Kodalith or Reprolith film with the filter. In any case do not forget the filter factor. A picture that has become yellow with age may be corrected by the G (orange) filter, which reproduces the stain so lightly that it is faint in the final print. A blueprint may be copied with a red filter to make the blue appear black.

HIGH- AND LOW-KEY PHOTOGRAPHY

A print with a "full scale" is one that includes all tones from solid white to solid black. The low-key print uses more darker tones than light; the high-key print uses only the lighter half of the scale. Though true low-key pictures may be recognized by the predominance of dark tones, the average picture of any sort may really be called a variety of low key. This is true chiefly because the high-key picture, to be truly high key, requires not only a great amount of light but careful arrangement of lights, proper selection of suitable subject, and careful execution. The high-key picture includes mostly light tones, with a few blacks for accents, generally as tiny areas or even as lines, care being taken to prevent the blacks from predominating and thus losing the high-key effect.

Portraits of women or children are best for high-key work. The background must be light, perhaps light blue or even white, and fully illuminated. The subject should have fairly light hair and be clothed in light-colored garments. Tiny touches of color here and there may serve as accents. View the subject through a visual filter or blue glass, using both eyes, and light the subject and background so that the face is just a shade darker than the background, and so that the shadows are light. This can be tested only by use of the viewing glass, which should be fairly dense. Exposure should be full or even slightly over.

INFRARED PHOTOGRAPHY

Ordinary white light is made up of light of all colors, and when white light is passed through a prism it is broken up into a band of colors called the spectrum. This band of color ranges from red

at one end to blue-violet at the other, and this is the visible spectrum. But at each end of the spectrum there is light of still other colors that cannot be seen by the human eye. Beyond the blue-violet there is light called ultraviolet, and beyond the red there is the infrared.

We may take pictures by this infrared light about as well as we take them with visible light, though a special film with an emulsion made sensitive to infrared light is required. Infrared photography can be used for several purposes. First, it is even better than ordinary film for the penetration of haze; second, it can give peculiar and pictorial effects to pictures. When used on a landscape it makes all clouds show up plainly against sky that is rendered dark, even black. The pictorial effect is bettered by the fact that trees and other foliage show up quite pale, light in tone, on infrared film (see Illus. 20). This is true because the green foliage reflects infrared rays. Also, the shadows will be deep because infrared rays will not be reflected into them.

To make a good infrared photograph, the picture should be taken by infrared light alone. In order to cut out the visible lights, block out the blue-violet in the light by using a red filter (A or F). The red filter requires much longer exposure.

The focus for using infrared film is somewhat difficult. Infrared rays do not come to a focus in the same place where visual light rays focus. For landscape work, with the lens set at 100 feet or beyond, the variation is not great, but for closer work some allowance must be made. In using a ground-glass camera, focus it with the red filter in place over the lens, if there is enough light to permit focusing. If not, focus the camera without the filter and move the bellows about 1/32 in. farther out, or with a helical focusing lens, turn the lens about 1/4 in. toward the next *lower* distance mark.

The difficulties of using infrared film include the fact that many substances are transparent to infrared light rays, as, for example, some woods and even hard rubber. If using cut-film holders, the metal ones are best. Also, when loading infrared cut film in holders, even though the darkroom seems to be perfectly dark to the eye you

cannot be quite certain that infrared light rays are not getting in somehow. However, you will have success with ordinary precautions.

Exposures for infrared film cannot be calculated closely. For a landscape, for example, use 1/25 or 1/50 sec. at wide aperture in bright sunlight. Proper exposures may be discovered by experimentation, though 1/20 at f:3.5 or equivalent (without filter factor) has come to be used as fairly standard. Cut film and plates are supplied by Eastman, and both Agfa and Eastman furnish this film in rolls.

Infrared photography is used in criminology, to detect alterations on documents, checks that have been forged, and even bloodstains. It can also be used to photograph hot objects in total darkness, because the hot objects emit infrared light. Some weird portrait effects can be made on infrared film, as flesh appears white, eyes look like black dots, and red lips record light.

PHOTOMACROGRAPHY

An ordinary camera, even as close to an object as it can be brought and still focused by any focusing means, even ground glass, will not make an image larger than the object itself. (Some view cameras, with double or triple extension bellows, can make slightly enlarged images directly.) This means that if you photograph some small object, about 1/2 in. long, on film 4 x 5 in., the image on the film will still be only 1/2 in. in length. Photomacrography is a method whereby this image can be made many times larger than the object, and a picture so made is called a photomacrograph. The image can be enlarged up to the size of the film.

Figure 32 shows a cross section of a camera using film 5 in. in longest dimension. The height of the object is one inch. On this 5-in. film the camera can make a picture of the object only 1 in. high as shown. The dotted lines, however, show how the image would increase in size back of the normal position of the film. If a

light-tight box is built onto the back of the camera, in which the film is placed at the position marked A, a much larger image of the object can be secured. This makes a photomacrograph. This method may be used to secure an enlarged image of objects that are not microscopic in size—that is, objects that do not require the use of a microscope to photograph them or even to see them. It cannot be used for objects as big or bigger than the film itself, but could in that case be used to photograph only a *portion* of an object. There are many subjects for this interesting type of photography. Some appear in advertisements; perhaps the works of a wrist watch,

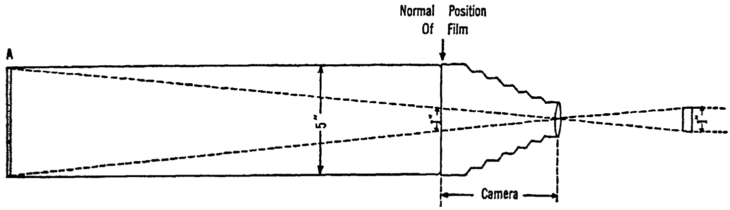


FIG. 32. PHOTOMACROGRAPHY DIAGRAM

grains of sand or face powder, insects (see Illus. 19), or pictures showing the texture of fabrics.

For this work the camera should really be of the ground-glass focusing type so that the light-tight box may be built to fasten into the grooves on the camera where the ground-glass or cut-film holders are placed. The other end of the box should be fitted with grooves so that the ground-glass focusing screen and the cut-film holders may be placed there. The length of the box determines the size of the enlarged image and the arrangement can be used to enlarge the image up to the size of the film used. Naturally, an object 1 in. square cannot be photographed to a size larger than 4 in. square on a 4 x 5 film. But when it is desired to take pictures of small objects that are only about 1/8 in. in size, as, for example, a small bug or a crystal, you need a much longer box back of the camera so that the film may be placed farther from the lens. A good outfit for photomacrography can be had by making the light-tight box in

several sections, so that as many sections can be used as are needed according to the size of the object being photographed or the degree of magnification wanted. Figure 33 shows a sectional arrangement.

It is best to use a small stage or easel in front of the camera to mount the object being photographed, and this should be placed about 10 in. from the lens, or twice the focal length. Two photoflood bulbs, one on each side, will give the necessary light. If the camera is mounted on the front section upside down, the image on the ground glass will then appear right side up (the lens inverts the image) and will be somewhat easier to focus.

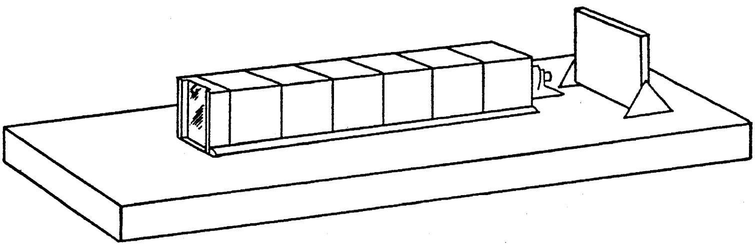


FIG. 33. SET-UP FOR PHOTOMACROGRAPHY

The exposure will have to be worked out by experimentation. Filters may be used the same as in copy work or in regular photography.

Do not confuse the term "photomacrograph" with "macrophotograph." *Macro* means big, and a photomacrograph is a picture that is *taken*, on the original negative, larger than life size; but a macrophotograph is simply a big photograph. Any huge enlargement, such as a photomural, might be called a macrophotograph.

PHOTOMICROGRAPHY

This branch of picturemaking includes the use of the microscope, and is, simply, photographing what the eye would see through a microscope. The camera replaces the eye, and any camera, even a box camera, can be used for this type of work. A knowledge of the technique of photomicrography is valuable for scientific work, espe-

cially medical work, as it enables one to make records of microscopic things that can be used either as enlarged pictures or as lantern slides.

The chief thing needed is a support to hold the camera in position at the eyepiece of the microscope. This connection must be light tight, and can be made by a piece of black cloth. The ground-glass focusing cameras are best for this work, because they permit the actual focusing to be done on the ground glass by eye. Ordinary

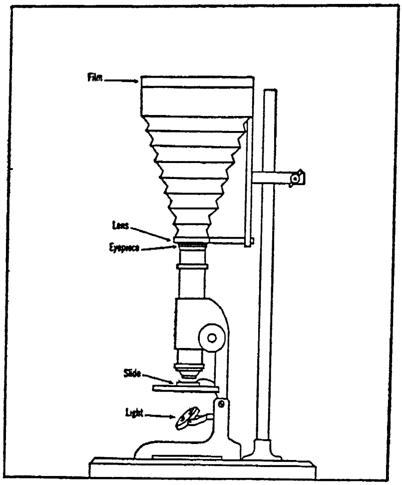


FIG. 34. PHOTOMICROGRAPHY DIAGRAM

folding kodaks that open at the back may be used as ground-glass focusing cameras by placing a piece of ground glass at the back of the camera with the ground glass side toward the lens. Other cameras, not made for ground-glass focusing or that cannot be equipped for ground-glass focusing, can be used with the lens set at infinity. In this case the microscope is focused by eye and the camera then attached (see Fig. 34).

With the subject on the stage of the microscope, the light and mirrors adjusted for good illumination, and with microscope and camera focused, a time exposure can be made. There is no good method of judging the exposure except by trial and error. It will

usually be 5 to 50 sec. You will find that you can secure fairly good pictures with a great many different exposures, because of the latitude of the film (see Illus. 21).

Filters may be used for photomicrography just as for copy work and for the same purposes. An orthochromatic film gives good results unless there are colors in the subject (on the slide) to record as they appear to the eye. The orthochromatic, which makes light colors lighter and dark colors darker, will give more contrast in the picture. Color film also can be used for this work.

Do not confuse the term "photomicrography" with "microphotography." Photomicrography includes the photography of images greatly magnified by the microscope, and a picture so taken is a photomicrograph. A microphotograph, on the other hand, is simply a microscopic-size photograph. In other words, it is a photograph that has been reduced to such a size where it can no longer be seen by the naked eye. You have probably seen microphotographs. They are common in Europe, and many European travelers bring home small stickpins or rings that contain a small piece of glass (a lens) which, when sighted through, shows the tiny picture that is inside.

POLARIZED LIGHT

Many good pictures have been spoiled by reflections. Also, it is difficult to photograph anything back of glass, as in a show window or a display case, because of reflections. It is for this reason, for example, that pictures made of store window displays are usually made at night so that the light thrown on the subject comes from back of the glass and not from the front. By means of filters that polarize light, however, reflections can be greatly subdued, and the action of such filters is discussed in this section.

Theory of Polarization.—A beam of artificial light, as thrown from a light bulb, vibrates in all directions. But light that has been polarized vibrates in one plane only. If you throw a stone into a pond, the ripples it causes move out in all directions, but a wave moves in one direction only. The ripples caused by the stone may be

likened to the vibration of ordinary light, and the wave may be likened to the vibration of polarized light.

If you fasten a string between two uprights and stretch it taut, then pluck it with the finger, it will vibrate in all directions as shown in Fig. 35-A. But if the same string is stretched through a cardboard that contains a narrow slit it can then vibrate only in the position of the slit, as shown in Fig. 35-B. If we imagine this string

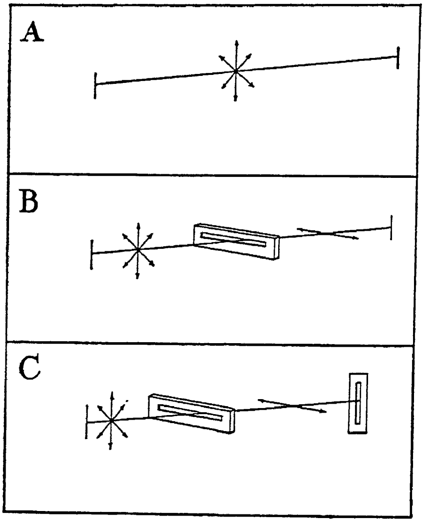


FIG. 35. POLARIZED LIGHT DIAGRAM

to be a ray of artificial light, moving from left to right, it vibrates in all directions when uncontrolled, but is polarized when made to vibrate in one plane. If this polarized light is acted upon by still another polarizing device, at right angles to the first, the light will be cut off entirely as shown in Fig. 35-C.

Polarizing filters (Eastman's pola-screens) are devices for polarizing light. These filters are made by placing a material (Iceland spar) that has the property of cutting out vibrations, in planes other than that in which it transmits vibrations, between two plates of glass, and their use is discussed below.

Use of Polarizing Filters.—First, the filter may be used to control the brightness of the sky or to eliminate from buildings reflections that hide detail. Ordinary sunlight is partly polarized, so that a polarizing filter over the lens of a camera headed at an angle to neutralize or cut off the reflections will greatly improve the picture. This position must be at a right angle to the direction of the sun's light; that is, the sun must be directly at one or the other side of the camera. If you have a ground-glass focusing camera you can sight the scene through the ground glass and rotate the filter to a position in which the sky appears darkened. If you do not have a ground-glass focusing camera you can sight the scene through the filter alone, turn it to the proper position, and then mount it over the camera lens *in the same* position. If, also, you use the red filter (A) you can secure a night, moonlight effect. As the polarizing filter itself requires a slight increase in exposure, use the next larger f: stop.

Besides the use of polarizing filters to secure pictorial sky effects and subdue building reflections, such filters may be used to subdue reflections from show windows in daylight. As in the case of the photography of buildings, the camera must be placed so that it is at an angle of 90° from the sun.

Artificial light, which is not polarized, becomes polarized when reflected from a nonmetallic surface such as glass, wood, or cloth, but only when reflected at a small angle. This angle is about 32° to 37° (see Fig. 36). For photographing something back of a glass, or in

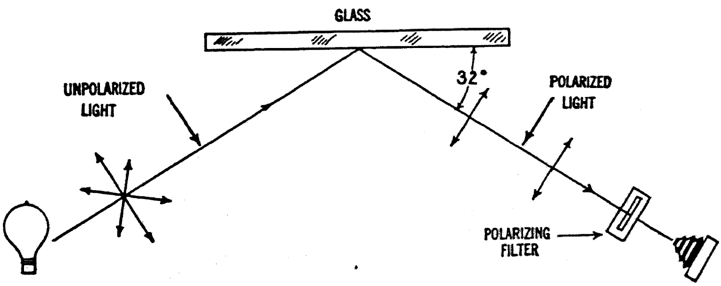


FIG. 36. ANGLE OF REFLECTION, POLARIZED LIGHT

a glass showcase, by artificial light, the oblique reflections from the glass may be subdued by using a polarizing filter over the camera lens with the camera in the position shown in the figure.

These filters may thus be used to subdue reflections for copying such subjects as oil paintings, or photographing furniture or products in transparent wrappings (such as cellophane), or for dark sky or night effects. As the exposure, even outdoors, will have to be increased to use the pola-screen (factor about 2 or 3), it is best to use a tripod; and the tripod is necessary for indoor work with artificial light. Use panchromatic film and calculate the basic exposure in the usual way, by use of either exposure meter or exposure table.

The use of polarizing filters for darkening skies or bringing out clouds is not an important one as these effects can be secured by an A filter. The unique use of polarizing filters is for subduing reflections that hide detail, especially in making advertising photos of various products.

SILHOUETTES

These pictures are easy to make with any type of camera and require little special equipment. Outdoor silhouettes can be made by shooting "against the sun," either early or late in the day, by posing the subject between the camera and the sun and then placing the camera in the shadow of the subject, quite low. The subject is outlined against the sky, and a comparatively short exposure should be made at medium or small aperture. The short exposure undertimes the subject so that no detail is shown in the subject itself, which therefore becomes simply a dark mass against the light background—in other words, a silhouette.

Indoor silhouettes are best made at night. The best arrangement for a silhouette picture is to use two rooms with an open archway between. Cover the archway entirely with a sheet of white cloth, and stretch the cloth smooth so that there will be no wrinkles. Place the subject in front of the screen, on the same side as the camera

and about 2 feet from the cloth. The subject should be facing sideways so that the silhouette will be made in profile (see Fig. 37).

Back of the sheet, in the other room, about 5 or 6 feet, place a flash bulb in a reflector. With the subject posed, all lights in both rooms turned off, open the shutter on bulb or time, make the flash,

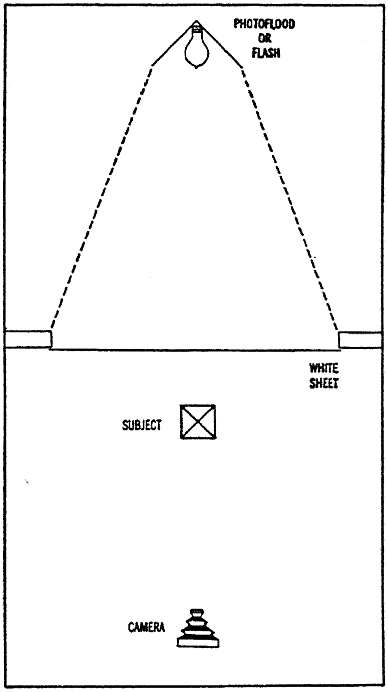


FIG. 37. SILHOUETTE DIAGRAM

and close the shutter. The aperture should be about f:8 or f:11, or even smaller for fast film.

Dark clothing is better for silhouettes than light, and make sure that no light is being reflected onto the subject from walls, doors, or mirrors. Ordinary light bulbs may be used for making silhouettes or you may use photoflood bulbs. For ordinary bulbs a long exposure is needed, perhaps 4 to 6 sec. (with three 60-watt bulbs) at

f:16. With photoflood (one No. 2 bulb) an exposure of 1 sec. at f:11 will probably do the trick. You may use any type of film, as color rendering is of no importance. Be sure the light source is hidden from the lens by the subject itself.

When making an indoor silhouette by daylight, place the subject in front of a window and cut off all other light in the room. Choose a window that has no dark object close to it outdoors, to secure a white background. Silhouettes are used for greeting cards (see page 204).

STEREO

The stereoscope is described in Chapter IV. The stereo camera is just like any other camera except that it takes two pictures of the same subject at one time, each from a slightly different angle. When these two pictures are finished and mounted on cards they may be viewed in a stereoscope, and the two images appear as one. As each of the two parts has been taken from a slightly different angle, the resulting effect gives third dimension, or depth, in the picture. Stereoscopic photography is coming back into style, but the old-style stereoscope shown in Fig. 38 (left) has been replaced by the modern stereo viewer, shown at the right in the figure, though the principle remains the same.

There is also available for miniature cameras a special lens which reproduces two images at once, and a special projection apparatus for throwing these onto a screen with stereoscopic effect has been devised. The stereoscopic effect is produced by polarizing filters in this way: one of the two pictures is projected through a polarizing filter which polarizes the light vertically and the other picture is projected through a polarizing filter which polarizes the light horizontally. The viewer then views the projected picture through a pair of spectacles made of polarizing filters, one horizontal and the other vertical. Only one of the pictures of the stereoscopic pair is seen by each eye and the stereoscopic effect is thus produced. Movies have been made in stereo and viewed by spectacles such as these, and they are fascinating. For many years the motion-picture industry

has tried to project three-dimensional movies, and it may be that it will adopt this method though some difficulties enter into it. One is that twice the amount of film will have to be used in the process of making movies and the other is that everyone going to a movie will have to have his polarizing filter spectacles. Short subjects (for

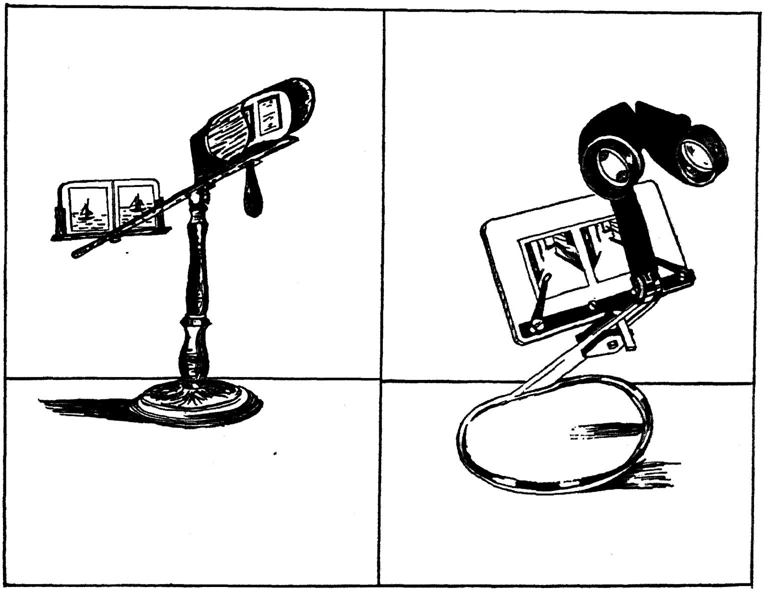


FIG. 38. STEREOSCOPES: OLD AND NEW

movies) have been made to be viewed through color spectacles, one lens red and one green. These pictures give the third-dimensional effect, produced in the same way as the polarizing filters produce it, except that the two images are of two colors slightly out of register. The colored spectacles worn by the viewer, being of two colors, permit the image of one color only to be seen by each eye.

To come back to stereoscopic photography, you can make stereo pictures with any kind of camera. All that is needed is a sliding base so that the camera can be moved sideways about 2½ inches. Take a picture of a subject with the camera at one end of the base, then

move it to the other end and take the second picture of the same subject. The subject must remain motionless, of course. The sliding must be perfectly straight so that the camera will not be at a different angle at one end of the base from the angle of view at the other end. There is also a stereoscopic tripod head built for certain types of cameras.

The pictures are taken in the usual way, whether outdoors or indoors; use the same film and exposure as for making a single picture, except that the stereo exposure may well be a little longer so that the shadows can show detail.

The prints from these pictures should be trimmed and mounted in perfect alignment. You do not even need a special viewer. Get two small magnifying glasses at the dime store and hold one before each eye. When you view your mounted stereo prints through these lenses you will see the subject standing out against the background, in third-dimension or stereo effect. Or, you may be able to buy an old-fashioned stereoscope at a secondhand store, though they are becoming collectors' items, and are somewhat rare.

STILL LIFE

This type of photography includes taking pictures of inanimate objects such as furniture, vases of flowers, books, bowls of fruit, either singly or in groups. It is fun to set up a group of objects in pleasant arrangement, perhaps a vase of flowers with a candle in a candlestick, or a pair of bookends with several books between them, grouped on a scarf or in front of a tapestry or figured wallpaper.

The lighting may be the same as for copy work, but may better be planned to give some particular effect, as, for example, to secure shadows where they will improve the picture or to light different sides of the subject. Use a tripod, as the exposure will probably have to be lengthened by the use of filters. Use a K2 filter for correct rendering of colors or use a contrast filter (such as red) to accentuate certain colors. Use panchromatic film.

Many still-life objects are small figures, and these may be grouped or placed in interesting attitudes or combinations. The figures

should then be photographed with an appropriate stage setting; this type of picturetaking has come to be called tabletop photography.

TABLETOP

Tabletop photography is not only interesting but fairly easy. It is so called only because the subject being photographed is usually posed on a table, and any camera can be used. With ordinary bellows cameras a portrait attachment should be used, so that the camera can be placed close to the subject. With focusing cameras get as close to the subject as possible depending on the size of the layout.

Tabletops are usually pictures of small figures in interesting or humorous poses or positions. Use little statuettes or make figures of wire, matches, paper clips, pipe cleaners, or cigarettes, or make a set with dolls and toys. The stage settings can be made from almost any materials available around the house. Water in a shallow dish or plate with some sand and a few blades of grass or even leaves makes a little lake surrounded by foliage. Much time can be spent in building the stage setting if desired. In any case, plan the picture with care. For "sky" use a light cardboard. Twigs make good miniature trees. For snow use salt or flour, or even cotton.

Put the figures in lifelike positions and all about the same distance from the camera lens so that some will not be out of focus, though a small aperture may be used as it is not important to make a short exposure. Focus carefully and trip the shutter with a cable release so that the camera will not vibrate. Two photofloods will give enough light, and the best lighting is from one side. Use a reflector on the opposite side for modeling. Keep the camera low so that the figures will appear tall and lifelike. Use panchromatic film and make every attempt to get the exposure just right. An exposure meter is a valuable accessory, though the exposure table for photoflood lighting may be used instead. Make several trials to determine the proper exposure. For shooting down at an angle, for some scenes, some special tripods are built of metal, with short legs, made especially for this kind of work.

TEXTURE

Texture is simply detail. It is obtained by shooting from as close as possible and still retaining sharp focus. Use a small aperture for greatest sharpness, with the light directed across the surface of the subject so that shadows will be cast by all the ridges and little extensions of the surface. The best texture is produced when the

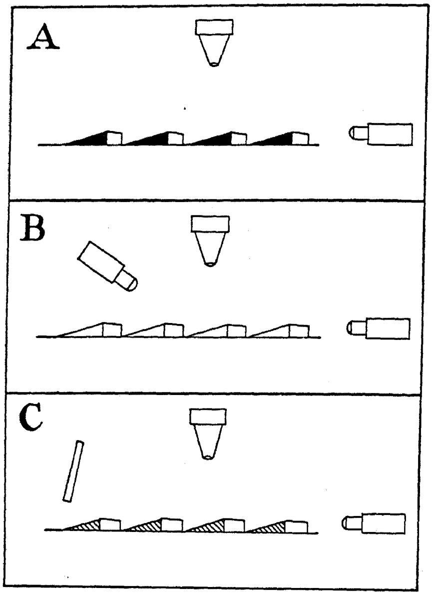


FIG. 39. TEXTURE LIGHTING DIAGRAM

light is placed at one side and quite low so that it just skims the surface. The best light source is a spotlight that can be brought down to a small beam.

Good subjects for texture photography are vegetables. Take a head of cabbage, an onion, or a celery stalk, cut it in two, and photograph the ends so that all the various lines will be shown. Other subjects can be grains of sugar or even sand lying on a flat surface. When lighted from the side each grain seems to stand up

as a tiny hill or mountain, and casts a long shadow. A slice of bread or toast lying flat also presents an interesting appearance when photographed this way. In fact, the range of subjects is extensive (see Illus. 22).

Figure 39-A shows the lighting directly from one side to produce long shadows. Figure 39-B shows the same arrangement but with an extra light to give illumination in the shadows. Figure 39-C shows the effect obtained by lighting the subject from one side and reflecting light into the shadows from the opposite side to give them only partial illumination.

Many variations of lighting may be used to produce new types of texture pictures. The camera must be close to the subject and the lens must be stopped down. Exposure can be determined by use of a meter or by experimentation. Panchromatic film may be used for colored subjects, assisted by the use of filters as needed.

TRICK PHOTOGRAPHY

Most trick photographs are made in the photographic darkroom, so they are more a matter of darkroom technique than actual camera work. One method of making trick pictures by the camera is by combination exposure. This process involves the exposing of one film two or more times, exposing either the whole film or part of it each time. For this work you need a tripod and something to cover parts of the lens. To cover the lens use a piece of black cardboard. As the mask must fit tightly, it is best to cut it to the size of the lens and use it in a filter holder.

For a two-section picture cut a section about 1/3 of the lens diameter from one side of the cardboard. Then take one exposure, reverse the mask and take another from the other side without moving the camera. If the mask has been made correctly, the two halves of the picture will blend together. If you have a streak running down the center of the picture, the opening in the mask should be made larger; but if the center strip shows overexposure, the opening has been made too large, in which case you will have to make a new mask with a smaller opening.

This process permits much variation. For example, make a picture of a friend posed as though he were talking to someone at the other side of the picture. Change the mask, have him move to the other side and pose the same way, but in reverse position. The resulting double exposure will be a picture of your friend talking to himself. Any kind of camera can be used but it is best to have a ground-glass focusing camera so that you can inspect the subject in the camera before you take the picture. In this case, of course, you remove the cut-film holder between exposures. With care you can even have the subject shaking hands with himself, and many other peculiar and novel effects can be obtained. Also, by a little experimenting you can have your subject in one part of the film much smaller or much larger than he appears in the other, or farther away on one side than on the other. For this work be careful that the background is shot from the same level and angle so that it can appear to be continuous in the picture, though the subject will have to move toward or away from the camera between exposures.

To make intentional double exposures without the use of a mask you can produce "spirit" pictures, by making use of the fact that a light object can be photographed against one of the same or darker tone. Photograph the light object first, giving it about half the normal exposure, and then expose the scene for the remainder of the normal exposure time, but without the subject. On the final picture the subject will look like a ghost.

Trick Mirror Pictures.—The photography of reflections is discussed in Chapter X. However, pictures made in curved mirrors or curved reflecting surfaces make true trick or fake pictures. The reflecting surfaces may be those peculiar curved mirrors that make persons look either tall and extremely thin or short and quite fat; they may be hubcaps on an automobile, or silver pitchers, or vases. The subject may be an individual, a group, or a whole scene. The only care to be taken is that the focus is set for the distance from the camera to the reflecting surface *plus* the distance from the reflecting surface to the subject, unless both original subject and

reflection are to show in one picture, in which case the focus is set for the distance from camera to the reflection.

Fake Speed Shots.—If you do not have a camera permitting exposures of 1/1000 or 1/1250 or faster you can still amaze your friends by faking speed shots. For example, you may make a picture of a juggler juggling several balls simply by pasting round white pieces of paper on a sheet of glass and photographing a person standing with his hands outstretched in proper position immediately behind the glass. Many other pictures can be made in similar fashion. To "stop" a bullet emerging from the mouth of a revolver stick a small piece of wire into the end of the lead bullet and the other end into a small cork. Push this cork into the barrel of the revolver so that it is out of sight, and photograph revolver and bullet from the side. This fakes an exposure of at least 1/100,000 of a second! You can photograph a person dropping an egg or other breakable object by attaching the object to a thread and hanging it from the subject's hand. There are many possibilities for faking "speed" shots.

Chapter XII

MOVIES

The world of pictures is open to the movie photographer as well as the "still" picturetaker. Nearly everything that can be photographed as a still picture, with an ordinary camera, can be used as a subject for motion pictures, whether or not the subject is actually moving. The best use of the movie camera is to record actions or facial expressions of living subjects. The rules of photography with respect to composition, aperture, framing views, and exposure hold good for motion-picture photography, with a few exceptions noted below. Movie work is itself a large subject, about which whole books have been written, and we can do no more in this one chapter than to mention the general rules and principles. Read the Eastman Kodak Company book, *How to Make Good Movies.*

OPERATION OF THE MOVIE CAMERA

The movie camera takes only one picture at a time, just as does the still camera, but the film is made in a long roll, many feet in length, and the mechanism of the camera is arranged so that picture after picture is taken on this roll of film, 16 pictures, or "frames," each second at normal speed. The film, when processed, is then run through a projection machine that throws the pictures on a screen, and, as the pictures pass before the eye so rapidly, the viewer is given the impression of continuous motion.

Film.—Figure 40 shows a cross section of a movie camera. The film comes from the supply spool on the spindle (2), passes over

the sprocket wheel (4), makes the upper loop (5), passes through the gate back of the lens, makes the lower loop (6), and is taken up on the spool (1). The footage indicator lever (3) is connected to a footage scale on the side of the camera. Number 7 is the view finder. The spring motor operates the sprocket wheel at a regular speed, and the teeth on the sprocket wheel fit into the sprocket holes in the film.

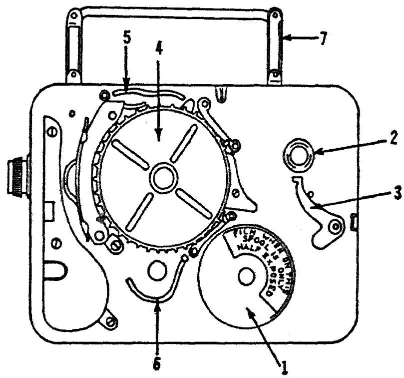


FIG. 40. OPERATION OF MOVIE CAMERA

Figure 41 shows comparative sizes of movie film. There are three standard sizes: 8 mm., picture size about 5/32 x 7/32 in.; 16 mm.,

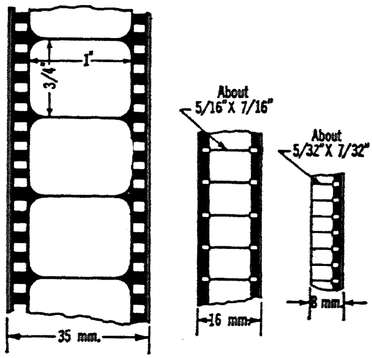


FIG. 41. COMPARATIVE SIZES OF MOVIE FILM

picture size about 5/16 x 7/16 in.; and the 35 mm., which makes pictures about ¾ x 1 in. The sprocket holes are in the edges of the film. The 8 mm. size has sprocket holes on one side only, because a roll this size (25 ft.) is usually run on special 16 mm. film which is then reversed and run on the other side. The manufacturer, in processing, cuts the film down the middle and fastens the two parts together, making a 50-ft. reel. Sprocket holes on one side only are enough for the projector sprockets to use to keep such narrow film straight and in motion, but the larger sizes require holes on both sides.

The 50-ft. roll of 8 mm. film requires 4 minutes to run in the projector. Since 8 mm. is only half as wide as 16 mm. and only half as high (picture size), the picture area is only one-fourth that of the 16 mm. This means simply that, since the projector shows the same number of pictures, or frames, each second, 100 feet of 16 mm. film will require the same projection time as 50 feet of 8 mm., or 4 minutes. Again, the 35 mm. film, which is the standard movie size, is over four times the size of the 16 mm. frame, so about 250 feet of this size are needed for a 4-minute movie show.

The following table lists a few movie films:

	Weston Speed	
	Daylight	Artificial light
8 mm.:		
Eastman Panchromatic	8	5
16 mm.:		
Agfa		
Panchromatic	16	12
Fine grain Plenachrome	12	8
Supreme	64	40
Finopan	24	16
Eastman		
Super X Pan	24	16
Super XX Pan	100	64
Kodachrome (also 8 mm.)	8	3
Kodachrome type A (also 8 mm.)	8	12

NOTE: Regular Kodachrome used indoors and type A used outdoors require filters.

Lenses.—Movie camera lenses run up to f:1.4, have stops down to f:16 or f:22, and are of short focal length, about 13 to 25 mm. or ½ to 1 in. On many movie cameras the standard lenses can be replaced by lenses of longer focal length for telephoto work. These longer lenses are 1½, 2, 2½, 3, 4, 4½, and 6 in. in focal length and vary in size from f:2.7 to f:4.5. The 2-in. lens makes the image of an object twice as high as does the 1 in.; the 4-in. lens makes it 4 times as high as does the 1-in., and so on. These can be used for making close-up shots from a distance, though they cut down the field of view.

Let us suppose that we are about to take some movies. The same things must be done with a movie camera as with a still camera to get ready to take pictures.

Focusing.—Many movie cameras are fixed focus. Cameras equipped for variable focus usually have lenses that revolve, and the distance in feet for which the lens is in focus may be read on the collar of the lens. Here, as in the case of the helical focusing lens on still cameras, the distance to the object to be photographed must be known, and the proper figure on the lens collar set for that distance. In any case, consult the manual that came with the camera. If you do not want to change focus for every shot (outdoors especially), set the lens for 25 feet and it will be in what is called "universal focus." The distance to the subject can be determined by use of a range finder, as described on page 18. No amateur movie cameras, so far, have been built with coupled range finder.

Here is one place where focusing for movie cameras differs from still camera work: some special terms are used. First, a shot that shows only the head and shoulders of a person is called a close-up, and a shot showing the person from the waist is called a semi-close-up. A full view of the person showing a little of the surrounding scene is called a medium shot, and a shot from far back is called a distant shot.

View Finding.—The camera focused, the next item is to frame the picture. Most movie cameras have eye-level finders, which means that the camera is held up to the eye and the subject brought into view by sighting through the finder. On many cameras the finder consists of a rectangular opening in a little frame standing up from

the top of the camera at the front, and a smaller rectangular opening in a little frame standing up at the back. The eye is placed close to the rear opening and the sight is made through both. Most direct view finders have lenses built into them for more accurate framing of the subject. The distance between the lens of the camera and the view finder lens is called "parallax." The best cameras have the field of view accurately outlined; that is, you get on the film almost exactly what you can see through the finder. Some movie cameras have the view finder built into them so that you actually sight *through* the camera. In using a movie camera do not quite fill the field of view with the subject, or part of the subject may possibly be cut off.

The Shutter.—The shutter of the movie camera is arranged so that pictures are taken on the moving film one after another. The average speed is 16 frames (16 pictures, or exposures) per second, and the processed film is run through the projector at the same rate of speed, so that the action is seen normally on the screen. The number of feet that have *not* been exposed is indicated on a dial on the camera. That is, when the camera is first loaded the indicator is at 25 for 8 mm. cameras or at 50 or 100 for 16-mm. cameras. When the roll has all been exposed the indicator shows zero.

Some movie cameras are equipped for various speeds. These speeds are usually 8, 16, 24, 32, and 64 frames per second; some higher priced cameras have all 5 speeds; some have only 3 speeds. If the camera is set to run at a low speed, as 8 frames per second, and the resulting film is projected at normal speed (16 frames per second), the subjects seem to move at twice the rate at which they are moving when photographed. This is commonly called "speeding up the camera," but the fast action is brought about by slowing up the camera. On the other hand, "slow motion" is accomplished by *speeding up* the camera to a faster rate, as, for example, 32 to 64 frames per second. If the camera is operated at a speed of 32 frames per second, and the final film is projected at normal speed (16 frames per second), the subjects in the picture will seem to be moving only half as fast. The reason for *faster* speeds is simply that details of the motion of persons or objects moving at various rates of speed

may be recorded. About 64 frames per second can show movement details of running horses or other fast-moving objects. Speeds faster or slower than normal require larger or smaller aperture, to equalize exposure.

Exposure.—The exposure varies according to the aperture. In speaking of a still picture exposure we usually refer to it in terms

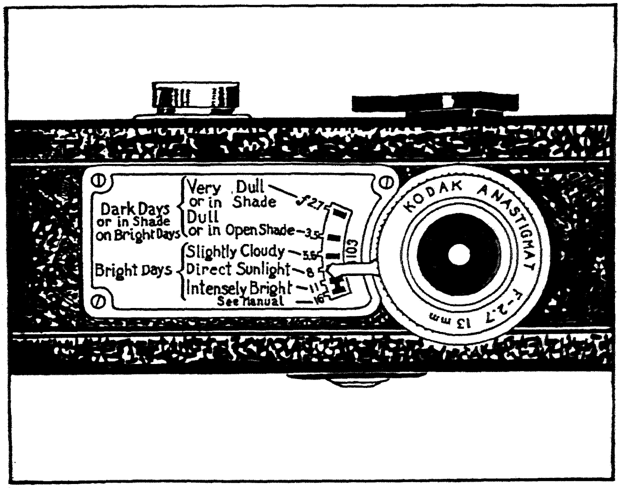


FIG. 42. EXPOSURE SCALE ON MOVIE CAMERA

of time together with aperture: 1/50 sec. at f:16, etc. In the movie camera the *length* of the exposure is fixed at 1/30 sec. (a few cameras use 1/40 or 1/50), so the aperture is all that is left to worry about. Many movie cameras have a scale built on the front showing where to set the aperture for the different light conditions, as shown in Fig. 42. Naturally, if the speed is 1/30 sec. you will need to have the diaphragm open wider for shots in deep shade and stopped down quite a bit for shots in brilliant sunlight, since you cannot change the *length* of the exposure. An electric meter can help you with this. The Weston Company makes a special meter for use in movie work, though the regular meter can be used simply by setting the calculator for the emulsion speed, then setting it for the intensity of the light, and reading off, on the scale, the aperture

figure that is set opposite the 1/30 sec. It is really simpler to use the meter for movie work than for stills. Also, regular movie film, both black-and-white and Kodachrome, comes packed with exposure tables.

For indoor work, under artificial light, an electric exposure meter can be used in a way that might be referred to as "backward." Set the meter calculator with the diaphragm stop you want to use (usually the widest aperture your lens has) opposite the 1/30 sec. speed. The pointer will then indicate how much light is needed. Then build up the lighting, by using more photoflood bulbs or by having them closer to the subject, until the light reading on the meter is brought up to the proper point. This is using the meter not to discover what exposure to give, but to find out how much light is needed, and it works very well this way.

Exposure for Kodachrome must be more exact than for black-and-white film. Follow the instructions that come with the film.

EQUIPMENT

Movie Cameras.—There are a number of popular movie cameras on the market. The following table is a list of a few of them, giving some information about each:

8 mm.

Name	Speed, Frames (per second)	Spring Run (in feet)	Lenses Available
Cine Kodak Eight 60	16	6	13 mm. f:1.9; 1½ in. f:4.5
Cine Kodak Eight 25	16	6	13 mm. f:2.7
Cine Kodak Eight 20	16	6	13 mm. f:3.5
Filmo "Aristocrat"	16, 32, 48, 64	5	12½ mm. f:2.5; 1 in. f:2.7; 1 in. f:1.5; 1½ in. f:3.5
Filmo "Companion"	8, 16, 24, 32	5	12½ mm. f:3.5
Filmo "Sportster"	16, 32, 48, 64	5	12½ mm. f:2.5
Keystone Eight K-8	12, 16, 84	4	½ in. f:3.5; ½ in. f:2.7; 1 in. f:1.9; 1½ in. f:3.5
Univex Cine-Eight A-8	16	6	½ in. f:1.9; f:2.7; f:3.5; f:5.6

16 mm.

Name	Speed, Frames (per second)	Spring Run (in feet)	Lenses Available
Magazine Cine-Kodak	16, 32, 64	11	25 mm. f:1.9; also 2 in., 3 in., 4 in., 4½ in., 6 in.
Cine-Kodak E	16, 32, 64	16	20 mm. f:3.5
Cine-Kodak K	8, 16	13	25 mm. f:1.9; also 2 in., 3 in., 4 in., 4½ in., 6 in.
Filmo 70-E	8, 16, 24, 64	24	1 in. f:2.7; also 2 in., 3 in., 4 in., 6 in.
Filmo 141-A	8, 16, 24, 32	12½	1 in. f:2.7; also 2 in., 3 in., 4 in., 6 in.
Keystone A-3	10, 16, 64	18	1 in. f:3.5; f:1.5; f:2.7; 3 in. f:3.5
Keystone A-7	10, 16, 24, 32, 40, 48, 64	15	same as A-3
Victor models 3-4-5	8, 16, 24, 32, 72	27	1 in. f:1.5; f:2.7

Choosing the Camera.—The first decision in choosing a movie camera is between 8 mm. and 16 mm. The 16-mm. size will cost about three times as much to operate as will the 8 mm., and 8 mm.-film (color too) is now being made so well that it permits pictures to be projected to fair size. On the other hand, if you want to do commercial work you will need the 16-mm. size. This size is made chiefly so that a clearer image can be projected to a larger size than permitted by 8 mm.

As to other points of choice, for ordinary work an f:2.7 lens is large enough, and the normal operating speed of 16 frames per second is sufficient. You will rarely need faster or slower speeds. For ordinary home movies, an 8-mm. camera with f:2.7 lens and single speed will be satisfactory. Doubtless in choosing a movie camera you will have to be guided somewhat by the amount you want to pay or can pay, and you will find that the more different things the camera can do, or the faster the lens with which it is equipped, the more it will cost. The movie camera should be cared for in the same way as other cameras. Remember to keep the lens clean because dust or fingerprints will reduce its efficiency. Cameras come with manuals of instruction for their care.

Other Equipment.—Other items of equipment are the things needed for still photography. The same filters are used on movie cameras as on still cameras, and in the same way. Although 1/30 sec. would be fast enough exposure to eliminate the tripod for still pictures, a tripod should be used for movie work whenever possible. Otherwise the scenes will be jerky, owing to the fact that the camera, if held in the hands, will likely show some up-and-down motion during the filming of a scene. Any good tripod can be used. A tilt-pan head is really of more value for movie work than for still work, because it permits the making of panoramas, and the following of moving objects. The tilt-pan head shown in Fig. 23 is satisfactory.

Always use tripod with a telephoto lens, for the lenses of longer focal length give so small a field of view that the subject can easily get out of the field. Also, do not make panorama shots with a telephoto lens. The same lighting equipment can be used for movie work as for still photography (see Chapter VI).

MOVIEMAKING

There are some things peculiar to movie photography. The photographic principles remain the same, but there are a number of things that do not enter into still photography at all. These are discussed below.

Scene Length.—How long should you hold your finger on the exposure lever? It has been said that the beginner holds a scene too long, and some beginners try to save film by making scenes short—too short, in fact. The correct answer is—as long as the type of action being recorded warrants. A scene of a child coming down a slide may well include the whole procedure—climbing the ladder, sliding down, and landing. It may require a slight panorama action, and the whole scene may require 10 seconds. Then, you may want a brief close-up, of three or four seconds, of the child getting up from the grass and arranging his clothing. A distant shot of a house and grounds should also be given about 8 or 10 seconds, though the following close-up of the front door, with someone coming out or going in, should have only 4 or 5 seconds.

Let the nature of the subject determine the length of the shot. A good average length is 4 or 5 seconds; count slowly to 5, or say 101, 102, and so on. This business of some short scenes and some longer ones brings us to our next subject.

Continuity.—In the first place, continuity means that the sequence of scenes should be sensible. The change from one scene to another should not seem pointless. For example, one scene of a New Year's Day party should not be followed immediately by a Christmas picture; summer and winter shots should not be mixed together; and a long series of daytime scenes should not be broken by a single evening scene. Also, you can make your movies tell a story, and this business of writing or at least planning regular scenarios is a fascinating subject in itself.

Scenario planning includes logical arrangement of scenes and the following of the rules of good continuity. Notice how regular movie scenes are usually introduced by long or distant shots, quickly followed by nearer views (medium shots), usually of two or more characters talking together, and note that these medium shots and semiclose-ups are broken by occasional close-ups of the chief characters, taken from different angles. This procedure makes for good continuity. When filming vacation trips it is a good plan to use distant, medium, and close shots for each principal scene. The distant shot shows your principle subject and its surroundings, so that the viewer can see at a glance how the chief point of interest is placed with respect to the general countryside. The medium shot shows this chief subject in its entirety, and the following close-ups show various details of portions of it. The viewer's curiosity is thus thoroughly satisfied.

It is fun to plan movies. Write a scenario listing each scene that is to be taken, before starting camera work.

It isn't necessary that you take all the scenes of your planned movie in exactly the sequence you want to show them, for film can be cut up and spliced again, and the process of preparing the film for projection is called editing.

Editing.—The first step in editing a batch of film that was taken on an excursion, picnic, or vacation, or was made for a planned movie, is to project it and jot down on paper the name of each scene or a description of it. Also put down on the paper, after the description of each scene, what you think should be done to it. For example, you may write on your paper, "Family sitting down to picnic table," and then say, "Cut part where George goes back to the

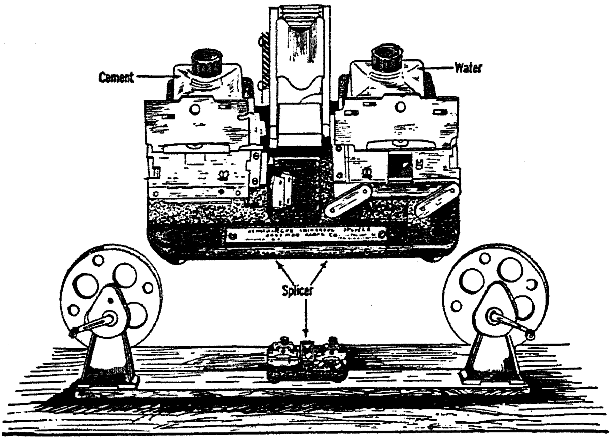


FIG. 43. REWIND BLOCK AND SPLICER

car after something." This means that you will take out of the roll the part that includes some action that delays the progression or that spoils the continuity.

Next place the film on a rewind block (see Fig. 43), which has a splicer mounted on it. The rewind block is simply a long flat board with a reel and crank mounted at each end. In the middle is the splicer unit, which consists of a cutter, scraper, and cover plates for pressure (see Fig. 43). The ends of the film are placed in the unit, one on each side. The cutter (two blades usually) trims the ends of the torn film, one edge is moistened, the scraper removes the emulsion from this edge, the cement is brushed on, the two ends are overlapped, and the cover plate presses them together.

That's all there is to splicing. Some rewind blocks have viewers mounted on them, as well as splicing unit. With these the film is projected onto a small ground glass, and a special lever nicks the film at the point you wish to tear it to remove some unwanted scene or part of a scene. Then all that is needed is to run your finger along the edge until you come to the nick, and tear the film at that point. Cutting and splicing is simple editing. To rearrange the order of scenes, they should be labeled, and the final film made up according to a plan written on paper, with each scene marked by some sort of key letter or number. This sort of editing takes some time, of course. Movie film, such as you see at the theaters, is edited in the same way, the work being done in the "cutting room."

Keep the hands clean, because finger marks are hard to remove even with good film cleaner. Don't try to tighten up loosely wound film, or it will cinch and show scratches. Film may be stored on reels of various sizes, in metal cans.

Titling.—You may want to include a few titles or subtitles in your movies, names for your shows, or occasional descriptions necessary so that the viewers may better understand or appreciate your movies, especially when you suddenly shift from one continuity to another. Use as few titles as possible, for the viewer tires of them easily. You do not need to title many scenes, anyway, because the audience usually recognizes them for what they are the minute they come onto the screen. What need is there to throw in a subtitle reading "We had a picnic lunch in the grove," and then go ahead and show the picnic itself? In vacation or travel pictures you can often avoid the use of titles by scenes of signboards or roadside markers. When you do use titles, word them simply.

Titling is done by means of a titler, a device arranged to hold the camera and the title being filmed (see Fig. 44). The title is written, typed, drawn, or painted on a card which is held upright in a frame while being photographed. Any sort of backgrounds for titles may be used: still photos, paper, cloth, metal, or whatever you wish. The title can even be on a paper strip pasted onto a photo, or

it may be on wallpaper, or on a picture in a book or magazine. The title is illuminated by a lamp over the camera lens, and the titling device includes its own special lens so that the title can be filmed at close range and still be in good focus. The device may also be used for copying and for photographing coins, flower petals, or other small objects, placed in the frame of the titler. If the object must be behind the frame, and you have a focusing movie camera,

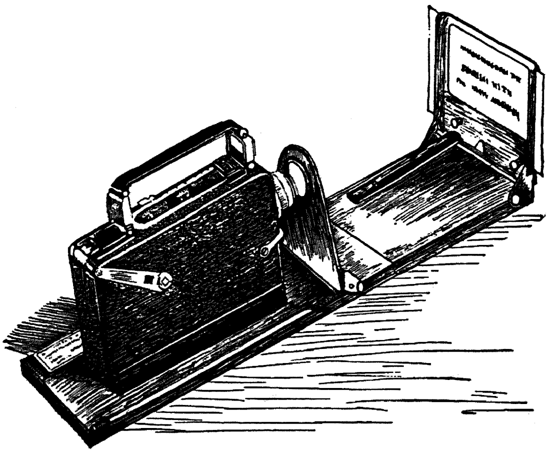


FIG. 44. TITLER

set the distance at the 100-ft. mark. For ordinary titling, however, set the distance for 25 feet.

Many novel titling effects can be made. For example, you may type or print a title on the back of a photograph and place a light behind the title frame as well as over the camera lens. When you have filmed the title itself, bring the lamp back of the titler up to the frame and move the front light away from the frame. The scene on the photo thus "fades in" and both it and the title can be seen at once.

Exposure for title should be as long as needed. While the title is being filmed, read it to yourself slowly, and, if the title includes a picture as well, allow a little longer.

Things to Keep in Mind.—

Hold the camera steady or, better yet, use a tripod.

Keep the subject in the center of the picture when panning.

Do panning as smoothly as possible.

Do not pan telephoto shots.

Take plenty of close-ups.

If a character leaves a scene at the *right*, it is best to have him enter at the *left* in the next scene in which he appears.

Watch the footage register, and do not use the film after the indicator reaches the zero mark, so that the balance of the film may be left for trailer.

SPECIAL MOVIE WORK

Fades and Dissolves.—The more expensive movie cameras are equipped with devices for making "fade-outs" and "fade-ins." The device is simply a little lever which, when pulled down, while the camera is running simply closes the diaphragm. This makes a fade-out. To fade in, the camera is focused on a scene, started running, and the diaphragm is opened by the same lever. If, after a fade-out is made, the film is reversed (with the diaphragm shut) to the point where the fade-out began and the next scene filmed is begun by fading in, the one scene fades out as the new scene fades in. Since one scene dissolves into another by this method, the process is called a "dissolve." As one scene really overlaps another, it is sometimes called a "lap dissolve." Fades are used to carry the viewer's eye smoothly from one series of scenes to another. In regular movies, fades are used to give the idea of lapse of time.

You do not need a special device to accomplish a fade. You can do it simply by cutting out the light entering the camera lens. This can be done either by closing the diaphragm on the lens to the smallest stop and then covering the lens or, if you are filming indoors, have someone place opaque cards in front of the light reflectors. Another way to make a fade is to shoot a scene through an open door and have someone slowly close the door. You can also fade in by this method.

Movie Tricks.—The easiest trick shots are, of course, slow or fast motion, and these can be made if your camera is equipped for variable speed. The chief thing to remember is that increasing the speed of the camera cuts down on the length of the exposure. For example, if you increase the speed to 32 frames per second, each frame will have only half as long a time before the lens as it would have at the normal speed of 16 frames per second. Therefore the exposure time will be 1/60 sec., as 1/30 sec. is the exposure time for the normal speed. You can compensate for this with the diaphragm: if the proper aperture at normal speed is f:11, when you double the speed the aperture should be opened to f:8. On the other hand, to use half speed, or 8 frames per second, and f:8 is the proper aperture at normal speed, stop down to f:11.

Another trick is called "stop-motion," which consists simply in stopping the camera in the midst of action. The characters can change their costumes, and come back before the camera. When the film is projected it will look as though the characters had made a lightning change of costume. Or, substitute one character for another, though be sure that the action being filmed the first time is resumed the second time or it will look like a change of scene. If you have an old man starting to raise his hand to his mouth to take a bite out of an apple and suddenly switch to a young girl doing the same thing, with the apple just reaching the mouth, the changeling effect will be startling. You can also have a person in full street clothing about to leap from a diving board into a swimming pool, stop the camera, have the person change into a bathing suit, and resume the scene from the beginning of the jump. Many things can be done with stop motion.

To secure reverse action, as, for example, to show a fish apparently leaping out of the water into a person's hand, all that is needed is to turn the camera upside down and film a scene of the person throwing the fish into the water. After the film is processed, tear this scene from the reel, turn it end for end, and splice it in. Keep the emulsion facing the same way as in the rest of the film, if using 16 mm. If using 8 mm. film, which has sprocket holes down one

side only, when you splice the scene back into the film you will have to *turn it over*, so that the sprocket holes will be on the same side as they are in the rest of the film. You can reverse objects (from right to left from the way they were actually in the scene) if the scene does not include a clock face or any reading matter.

There are many other trick devices: rocking the camera to produce a seasickness effect or using double or multiple exposure, just as for still pictures. And you can make movies in mirrors, either regular mirrors or curved reflecting surfaces.

Animation.—You can make animated cartoons if you are an artist and have the necessary patience. Animation is accomplished by photographing a long series of drawings, each single picture showing a small change in the position of the subject. Each picture is exposed for only a frame or two. Some cameras are equipped for single-frame exposures but you can nearly accomplish it with any movie camera simply by pressing and releasing the exposure button quickly.

A simpler type of animation is to build little scenes as for table-top photography and use small jointed dolls, or even figures made up of wire hairpins, paper clips, or pipe cleaners. This sort of animation may be assisted by creating motion in objects in the scene by means of threads fastened to them.

Enlarging.—The 16-mm. movie frames permit small enlargements, especially of the close-up shots. The 8-mm. frames can be enlarged but not much more than to a picture 1½ x 2 in. The process is mentioned here simply because it may occasionally be desired to preserve an especially good shot, and the usual process of making enlargements can be the same as for enlarging from negatives made with still cameras (see Chapter XV). Remember that the movie film, as used in a projector, is positive and not negative. This means that the enlargement must be made on film, which then becomes a negative, from which prints can be made. The Eastman Company produces a special enlarging apparatus built like a folding camera and using regular roll film. In front of the lens is a clamp for holding the film, and, to use this device, the roll of film need not be cut.

Simply clamp the film in the gate in front of the enlarger lens with the desired frame in the center position.

Projection.—There are no special rules for operating projectors, except that you must have a projector for the size film you want to show. The better the projector the better your movies will appear. The only other thing you need is a screen, and a good silver-surfaced or beaded screen is best. Besides showing movies that you have made yourself, you can rent many reels in either 8- or 16-mm. size.

Part III

DARKROOM WORK

Chapter XIII

DEVELOPING

THE DEVELOPING SOLUTION

Theory of Development.—Film is made up of a transparent flexible film base upon which the emulsion is coated. When this has been exposed to light, the light striking the emulsion affects the small particles of silver bromide suspended in it. Development is the process of taking the bromide from the silver bromide that has been exposed to light, precipitating in its place a deposit of pure silver of greater or lesser density (ranging from black to white), depending upon how strongly the light affected a given area. When this has been done and the fixing, washing, and drying processes performed, the result is what is called a "negative" image (refer to Illus. 24). Where the original subject photographed was lightest the deposit of silver is heaviest (densest), and the negative image is darkest, because these are the areas that receive the most light reflected from the subject, and the light, admitted by the camera lens, affects the film more intensely in these areas. It naturally follows that the darker, or shadow, portions of the original subject will reflect less light, so that the corresponding areas of the emulsion will be less affected, the deposit of silver less dense, and the negative image lighter in these areas.

A negative, therefore, is light where the original subject was dark, and dark where the original subject was light. To secure a picture, a "positive" image, of the subject it is necessary to perform an extra

process, to reverse these dark and light areas again. This process, printing, will be discussed in the next chapter.

What a Developing Solution Contains.—A developer is a chemical that can take the bromide away from the silver bromide, and it must be a chemical that will act only upon the tiny particles of silver bromide *that have been exposed to the light.* There are a number of different chemicals that will do this job, and the most important are:

Pyrogallol (pyro)
Hydroquinone
Metol (called Elon by the Eastman Company, Rhodol by the DuPont Company, and Pictol by the Mallinckrodt Company)
Amidol
Glycin (Athenon)

The developing agent *by itself* has little power to do any developing. It will act only in a solution containing another type of chemical known as an alkali. The alkali that is most used for developers is sodium carbonate (sal-soda). A few developers use caustic soda (sodium hydroxide) because this gives a high contrast. Caustic soda is not easy to handle because it will burn the fingers. Other alkalis used in some developers are borax, sodium metaborate, or Kodalk. The amount of alkali controls the energy of a developer; if too little alkali is present, the developer will be slow. On the other hand, if there is too much alkali, the developer will be so fast that fog will be produced. Also, too much alkali might soften the gelatin of the emulsion and make it blister. This is especially true in warm weather.

The two commonest developing agents (metol and hydroquinone) act somewhat differently. By the action of metol the image appears quickly and all over the film at once. With hydroquinone, on the other hand, the image appears less rapidly and the portions with more exposure will appear more quickly. In fact, by the time the shadows (the light portions) appear on the film the highlights (the dark portions) will have become pretty dark. Thus, metol develops detail first and then builds up the silver deposit, while hydroquinone builds up the blackness of the silver deposit first and then detail.

Consequently, these two agents are used together in most developers so that the solutions can have the advantage of the special action of each.

The amount of the heaviness or blackness of the silver deposit per unit area is measured as "density." A density that permits the film to transmit 1/10 of the light shining through it is called unit density, and is considered normal density. The darkest part of a negative may, therefore, have a density of 2 or even more, and the shadows (the lightest parts of the negative) will be quite thin, perhaps only 1/10 of normal density. A good "crisp" negative will range in densities from about 1/10 to 2, and should have most of the intermediate densities as well, with the medium tones about normal. The difference in density between the darkest and the lightest portions is called "contrast." Both contrast and density increase during development.

This developing mixture will not keep well because it has a tendency to take up oxygen, and thus do what is called "oxidize." So another chemical is added to the mixture. This is usually sodium sulphite, which takes up oxygen and does not permit the developing agents to do so. The sulphite will even take oxygen away from a developing agent that has become oxidized.

Our mixture now contains metol, hydroquinone, sodium sulphite, and sodium carbonate. Owing to the fact that this mixture has a tendency to develop some of the unexposed silver bromide as well as the exposed, something must be put into the solution to hold back this action. The chemical usually used for this purpose is potassium bromide.

The standard developer, therefore, contains metol, hydroquinone, sodium carbonate, sodium sulphite, and potassium bromide. Developer formulas are given in the Laboratory Manual.

HOW DEVELOPMENT IS DONE

Some Rules to Follow.—First of all, remember that film is sensitive to light until after it has been developed, so all developing must be done in light that is safe for the film. Panchromatic film

being sensitive to light of all colors, no light is safe for this type of film, and it must be developed in total darkness. Verichrome, an orthochromatic film, and other films of this type can be developed under a red light, as this film is not very sensitive to red. However, it is best to do all film developing in the dark, or at least by keeping the film itself in the dark.

The best control of development is by what is called the "time and temperature" method. In the old days, with slow photographic materials, and materials only slightly sensitive to colored light, photographers used to develop their negatives under a dim light. They could then watch the progress of development and remove their negatives from the developing solution when the desired point had been reached. But modern film is not only much more sensitive to light but is also sensitive to light of all colors, which means that it *must* be developed in darkness. Consequently, it must be developed by the time-temperature method. This means that you must know the temperature of the developing solution and how long to develop the film for the temperature of the solution.

A developing solution will work best at 65° F. If the developer is colder, the chemicals will not act so rapidly; if it is warmer, they will act too rapidly. A thermometer is needed and it should be made of glass or some material that will not be affected by the developing solution. If the solution is too cold it can be warmed by placing the tray of developer in a larger pan of warm water; it can be cooled by placing it in a pan of cold water. Different developers require different lengths of time, and the time itself will vary according to the temperature. In the Laboratory Manual the proper developing time is given for each solution. Many films, especially cut film, come packed with developing instructions: the developer formula recommended by the manufacturer and the time of development for different temperatures. However, 65° F. is the best temperature to use, and this temperature is used by most photographers.

Developers themselves may be mixed in the darkroom or, bought in powder form, may be dissolved in water. They may be secured

in quantities sufficient to make one-half pint, one quart, one-half gallon, or a gallon of solution.

Methods of Development.—Film may be developed by one of two methods: (1) tray or (2) tank. Trays, of course, are simply shallow dishes, and may be used for development of any kind of film. Tanks differ according to the type of films for which they are intended. Tanks for the development of roll film are usually round, made of metal or hard rubber, with light-tight lids. These tanks have reels on which roll film may be threaded, and this threading must be done in the dark. The reel is then placed in the tank, the cover is replaced, and the developing process may be carried on in daylight or artificial light, as the tank is really a miniature darkroom in itself.

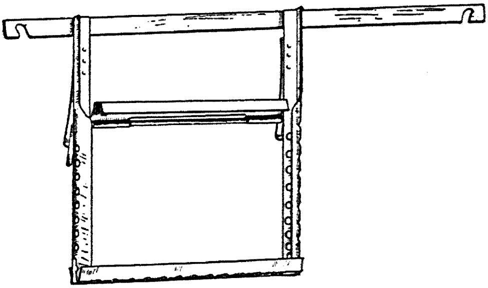


FIG. 45. CUT FILM HANGER

There is also a special type of tank built with compartments to hold the 12 pieces of film of a film pack. These tanks are loaded in the dark, covered, and the developing process run as in the case of the roll-film tank. Tanks for cut film may or may not have light-tight covers. Cut film, when removed from the film holders in which the films have been exposed in the camera, may be attached to clips fastened onto metal rods which then rest on the edges of the tank with the film itself immersed in the solution. There are also cut-film holders made into metal frames in which the pieces of cut film are inserted (see Fig. 45). These are better than the clip hangers because the frames keep the pieces of film from touching each other.

Developing Roll Film.—Here are instructions for developing roll film, by the tray method:

(1) Remove the roll film from the camera and take it into the darkroom.

(2) Place the equipment so that you can handle the film in the dark without too much fumbling. For tray development use four trays, 4 x 6 in. or larger, placed in a row. The first tray contains plain water. The second tray contains the developing solution at 65° temperature.

(3) Unroll the film and remove it from the paper back. As you remove it from this backing it is best to put a clip on each end. (The clip can be a simple clip clothespin if you wish.) The film has a tendency to curl up into a rather shapeless mass, so it should be held by each end and run back and forth a number of times in the pan of water, which softens it and makes the rest of the developing process easy to perform. In this process (wetting the film), have the film turned emulsion side down. The film will "run" through the tray quite easily by alternately raising and lowering the arms (see Fig. 46). When the film becomes limp you are ready for the next step.

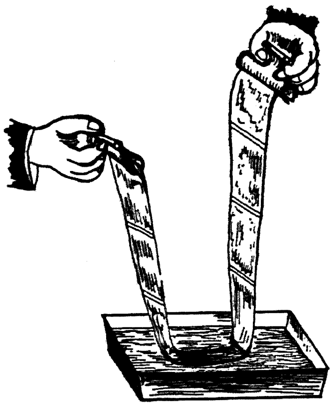


FIG. 46. TRAY DEVELOPMENT, ROLL FILM

(4) The developing solution is at 65° F., and an average time for tray development of roll film is 5 minutes, though in this you may be guided by instructions for the developing solution you are using (see Laboratory Manual) or special instructions that come packed with the film. To know when the film has been developed for the proper length of time you need a time clock. There are several photographic clocks that can be set for an interval of time, which, after that interval has passed, will ring or buzz to indicate that the time is up. If developing orthochromatic film under a red light, you can note the time on a regular clock. Pass the film back and forth through the developing tray slowly, holding it by the clips

and with the bottom of the loop always under the surface of the developer. The emulsion side should be *up* for the development.

If using a tank, do not wet the film. After the film has been removed from the paper backing and threaded into the reel, put the reel in the tank and put on the cover. (Figure 47 shows an adjust-

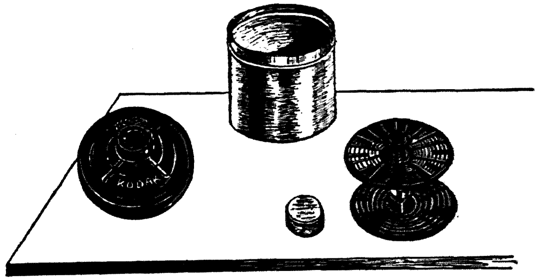


FIG. 47. ADJUSTABLE ROLL-FILM DEVELOPING TANK

able roll-film tank.) Then pour the developing solution into the tank. This solution should be at 65° F., whatever developer you are using. The time of development in a tank is longer than for a tray, perhaps 12 to 20 minutes, or even longer, and most tanks come packed with instructions for time-temperature. After the time has elapsed the developing solution is poured from the tank back into the bottle, and the film is ready for the next step of the process.

Developing Other Films.—For film pack first place the pieces of film in the special film pack tank (see Fig. 48), after which proceed as for development of roll film in tank. Or, develop the pieces of film separately just as with cut film.

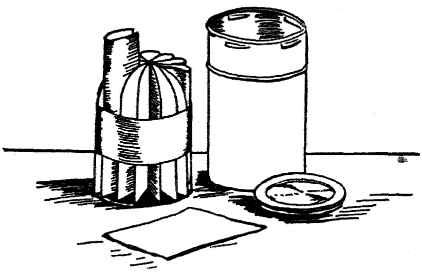


FIG. 48. FILM PACK DEVELOPING TANK

Cut film, when removed from the holders, may be developed in either tank or tray. (The latter is not so satisfactory as the former.) Attach the pieces of film to the clip rods or place them in frame holders. For tray development these should be slipped into a large tray of developer and developed for about 5 minutes at 65° F. The tray should be rocked so that the developer will flow over the pieces of film to ensure even development. This rocking of the tray is called "agitation." If using a tank, the pieces of film may be immersed in the tank while hanging from the rods or while in the frame holders. Tank development, as in the case of roll film, is much longer than tray development, and agitation may be done simply by raising and lowering the hangers.

SHORT-STOP BATH

The short-stop bath is used for roll film, and may be used for cut film if desired. It is simply dilute acetic acid, and its purpose is to arrest the process of development. If using tray development, the next tray is the one containing the short stop. (For formula see Laboratory Manual.) Run the film, emulsion side up, through this short-stop bath for about 30 seconds. This bath helps to prevent stains and saves the hypo bath which is used next. If developing cut films in a tray, after development they are transferred to a tray containing the short-stop bath. If using film tanks, after the developing solution has been poured out of the tank and back into the bottle, simply pour the short-stop into the tank. If developing cut film, suspended from hangers, it may be moved from the developing tank into another tank containing the short-stop bath.

FIXING

The next process is "fixing." If using a tank, pour the short-stop bath back into the bottle and pour the fixing bath into the tank. If using tray development, the roll film is next run, emulsion side up, back and forth through the fourth tray containing the fixing bath. Cut film, being developed in trays, should be moved from the short-stop tray into the fixing tray.

Referring to our history of sensitive materials at the beginning of Chapter V, you doubtless remember that the fixing bath is used to dissolve out of the emulsion the unexposed and undeveloped grains of the silver bromide. If this is not done, these grains will darken when exposed to light and cover the image on the film. It is, therefore, necessary to "fix" thoroughly before the film can be viewed in the light. (See Laboratory Manual for formula for fixing bath.) The usual length of time for fixing is twice the time the film takes to "clear," or twice the time necessary to dissolve the milky appearance from the film base. The length of time necessary depends largely on the strength of the hypo, or fixing solution, and this depends on how long the solution has been used. Fresh hypo acts more quickly than old. Hypo is cheap—use fresh baths.

The fixing bath also contains some hardening agent, such as alum, which hardens the gelatin and keeps it from swelling or softening, and there is also some acetic acid in the solution to neutralize any developer that may be "carried over" into the hypo. Because developer carried over into the fixing bath oxidizes and turns the fixing bath brown, so that it might stain negatives, some sodium sulphite is put in the fixing bath to prevent the oxidation.

WASHING AND DRYING

The film should be washed in a tank or tray of running water for at least a half hour. For this purpose use a dishpan, washtub, or tray under a water faucet or, if you cannot use running water, use six changes of fresh water, allowing the film 10 minutes in each change, and with frequent agitation. The washing must be thorough so that the hypo may be entirely removed from the film. If it is not thorough, the image on the film will not be permanent, but will fade out in time. If using a tank, the film may be washed by placing the tank under a water faucet so that the water can run in and out.

After washing, the film should be hung up to dry. With roll film, hang up the whole strip by one end and leave the clip on the other end to weight it down so that it will dry straight. Cut film in

hangers may be left in the hangers and the hangers themselves hung on your "line," as most hangers have hooks for this purpose. Carefully wipe the film with a wet and wrung-out viscose sponge to prevent water spots. When dry, roll film may be cut into the individual negatives, which are then ready for printing. This process will be discussed in the next chapter.

TREATMENT OF NEGATIVES

There is one treatment that can be given film *before* developing. This is desensitizing, though it is not recommended for frequent use. If a panchromatic film (which must be developed in total darkness) is treated in a desensitizing solution (see Laboratory Manual), its sensitivity to light is greatly reduced without affecting the image. However, as desensitizing chemicals are expensive, and as the time-temperature method of development produces excellent negatives, you should rarely need to desensitize film.

There are three things that can be done to negatives *after* development, if they need it:

Reduction.—This is a process used for negatives that are too dense to print readily or negatives that are so contrasty that the prints will be harsh. The process is simply the removal of some of the silver from the image by use of a chemical which will dissolve the metallic silver. If a normally exposed film has been overdeveloped it may be too contrasty, and certainly it will be too dense. It needs reduction. If it has been overexposed, even though it may have normal development, it will be too dense, and the excess density can be cut by reduction.

There are two kinds of reducers. One takes an equal amount of silver from all parts of the image. The other acts upon the negative in proportion to the amount of silver present. This type is called a "proportional" reducer and it is used for a normally exposed but overdeveloped negative. The type of reducer that removes an equal quantity of silver from all parts of the image is simply a "subtractive" or "cutting" reducer and may be used for overexposed nega-

tives. For formulas and instructions for using reducers see Laboratory Manual.

Intensification.—This process is the direct opposite of reduction, and is used to increase density or contrast. It is not so simple a process as reduction because it involves an additional operation. Negatives that are too thin or too weak to print, because of either underdevelopment or underexposure, may be given the intensification treatment. An increase of density can be had by depositing some other chemical on the silver image, and a common intensifier is chromium. The first step in the process is to bleach the image on the negative; the next step is to wash the negative in water and redevelop it. The time of redevelopment determines the degree of intensification. For formulas and instructions for intensification see Laboratory Manual.

Retouching.—The retouching of negatives is an art in itself and not more than one photographer in a hundred is really good at it. A retouching desk is simply a slanting shelf of ground glass with a light behind it. Work in a darkened room with the light shining through the negative to be retouched. You can build such a retouching desk of wood or cardboard with little trouble.

You will need a mechanical pencil, or lead holder and several leads. These leads come in various grades and you should have at least the H, 2H, and 5H. The 2H can be used for most retouching work. You need cotton, India ink, a small brush, and a sharp knife.

Before retouching, a negative should be "doped" with retouching fluid, a liquid put on the negative so that it will hold the pencil marks. Retouching can be done on either the emulsion or the base side of the film, though the base side is somewhat preferable as it permits bad retouching to be washed off and done over.

Small white spots caused by dust particles can be filled with a soft lead (H) or with ink. The same process can be used to fill small scratches. Retouching can be used to take out freckles or pimples. Remember that a light portion of the negative will show dark on the print and that a dark portion will show light on the print.

For filling in portions with penciling there are several different

strokes to use. One is a very small circle made as though you were practicing penmanship. The letter S or the figure 8, or crosses and dots are other strokes, though the dot method is very slow. For shading open spaces the figure 8 is probably the best.

It is not advisable to go deeply into the matter of retouching, which includes special techniques for working on eyes, chins, lips, noses, etc., without having at hand a good book on this subject, such as *Retouching Negatives and Prints from A to Z*, by Beulah Ross, or *Art of Retouching Photographic Negatives*, by Bruce and Hammond.

How to Judge a Negative.—A dense negative is one that has quite a black silver deposit. A negative that has little density is called "thin." If there is great difference between the density in the shadows and the density of the highlights, the negative is said to be "hard" or "contrasty." On the other hand, a negative that has little contrast is called "soft" or "flat." A "weak" negative is one that has both little contrast and little density. There is a special instrument for measuring the density of the negative. This instrument is called a densitometer. By placing the negative on a glass-top table or desk, such as a retouching desk, with the light shining through it from beneath, an electric exposure meter can be used as a sort of densitometer, though you will have to work out your own density values as expressed in the readings of the meter. With a table of these, you can at least determine how negatives differ in density.

The image on a good negative should be brilliant; the shadows should be clearly outlined and with detail in them. Correct exposure and correct development will give good detail in the shadows, and should also give variations in the brightness shown. This variation, ranging from almost white to almost black, with many intermediate tones, is called the "scale." A negative that is too contrasty will have whites and blacks and few intermediate tones. Illustration 23 shows (in sections) an underexposed, normally exposed, and overexposed negative (right to left); and does not differ greatly in appearance from one under-, normally, and overdeveloped in the same sections.

Some Faults in Negatives.—The following are some faults in negatives, with causes and remedies:

Defect	Cause	Remedy
Negative thin and without detail	Underexposure	Intensification
Image out of focus	Poor focus	None (focus better next time)
Blurred image	Motion of camera or subject	None
Negative too dense	Overexposure or overdevelopment	Reduction (also, use soft contrast printing paper; see next chapter)
Negative flat and thin	Underdevelopment	Make prints on contrasty paper
Negative retains milky appearance	Incomplete fixing	Refix, wash, and dry
Bubbles on negative	Hypo too cold	None
Part of image is positive	Exposure to light during development	None
Fingerprints	Incorrect handling	Usually none, though try film cleaner
Negative stain	Use of exhausted developer or fixing bath	None

Gamma.—This is a photographic term that means simply contrast. It is used in technical photographic literature to describe degree or amount of development contrast. A negative with gamma of 1 is considered normal contrast (same as in subject photographed), and some photographic instructions may include such advice as "develop to gamma 0.8" or "develop to gamma of 1.2."

SPECIAL DEVELOPING

Fine Grain.—A fine-grain developer is one that will make the particles of silver in the image tiny indeed, with, consequently, less space between them. Until a few years ago fine-grain development was used chiefly for developing negatives from which enlargements were to be made. Now its chief importance is probably for

the developing of miniature camera film, since the making of even a moderately sized picture from the miniature negative is, in fact, making a big enlargement. Development is done by the time-temperature method and is usually long, though overdevelopment will destroy the fineness of grain. An example of fine-grain developer is Agfa 17. Fine-grain development is a subject much discussed today. Read *Champlin on Fine Grain*, by Harry Champlin.

Infrared.—For the development of *infrared* film any developer can be used, but D-76 (about 15 min.) or Agfa 17 (6-8 min.) is recommended.

Silhouette Pictures.—Negatives for silhouettes must be contrasty so that only blacks and whites will record. This effect can be obtained by using a high-contrast developer such as D-11, D-19, or D-72, and increasing the length of the development.

Dufaycolor.—In Chapter XI we learned how Dufaycolor film is made and how it works. The development is what is known as "reversal development," in which the negative image is bleached out and reversed to a positive.

The film is first developed in the usual manner, but instead of fixing or dissolving out the unexposed silver, the film is placed in a bleaching bath which dissolves the black image developed in the first process. The balance of the emulsion is still sensitive to light. After the bleaching the film is exposed to white light and then redeveloped, thus forming a positive image. Instructions for processing Dufaycolor film, together with the necessary formulas, are included in the Laboratory Manual.

Chapter XIV

PRINTING AND FINISHING

THE PRINTING PROCESS

THE printing process is similar to the making of a negative on film. The illumination of the original subject is reversed on the negative, light areas showing as dark patches, and vice versa. If the negative so made is placed emulsion side against an emulsion on a piece of paper, and exposed to light, the resulting print will again reverse the dark and light areas, and a positive will result that is a reproduction of the original subject. The light-colored areas of the subject, represented on the negative by dark areas, are dense and, consequently, permit less light to pass through the negative to record on the paper. These areas on the final print will again be light in tone, like the original subject. On the other hand, the dark areas of the original subject, that reflect little light, record less heavily on the negative, so that these areas on the negative are quite light, and, as a result, pass light readily to record dark again on the print. Examine Illus. 24, which shows negative and positive images.

Printing papers are made in the same manner as are films, the emulsion being coated on paper instead of on a transparent, flexible base. There is one other difference, however: the emulsion on paper is much slower than the emulsion on film, and two different light-sensitive materials are used. The first is silver bromide, which is the light-sensitive chemical used on film. This emulsion makes the fastest printing paper. Then there is another emulsion containing silver chloride instead of the silver bromide. This emulsion is slower than

the bromide, and is used for contact printing, that is, printing by placing the paper and negative face to face in a printing frame or in a specially built printer. The bromide papers are used for enlarging, or projection printing, in which the negative image is projected by means of a lens onto an easel holding the sensitized paper (see Chapter XV).

HOW TO MAKE PRINTS

Exposure.—The first step in making prints is the exposure to light. For this purpose you need one of two things: (1) a printing frame or (2) a printing box. You are doubtless familiar with an

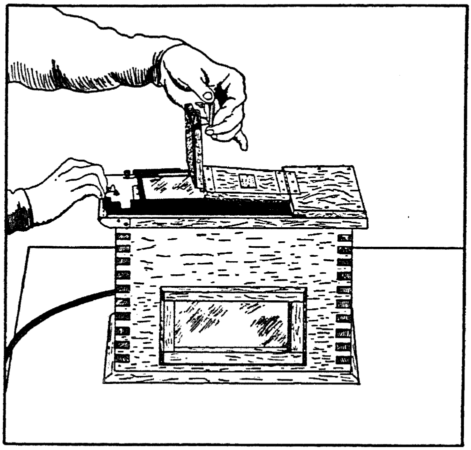


FIG. 49. KODAK AMATEUR PRINTER

ordinary printing frame, which consists of a rectangular frame built to hold a plate of glass and a back that clamps against the glass. These are made in various sizes, such as 4 x 6, 5 x 7, 6 x 8, 8 x 10, 11 x 14 in., etc. A printing box is simply a box with electric light bulbs at the bottom and the equivalent of a printing frame at the top (see Fig. 49). The advantage of the regular printer is that you can do developing of prints while printing others, as the bright

light used in making the exposure is inside the printer itself, and, consequently, does not illuminate the darkroom. In using a frame, of course, you need an electric light bulb, preferably in a reflector placed at a small distance from the frame. A reflector suspended about 1 to 2 feet above the worktable will do the job. The printer usually has flat metal strips that can be slid along two sides of the ground or opal glass in the top, so that you can "mask" the negative to print just the portion you desire to use; the best printing frames have masking devices. If your frame is not equipped for masking, you may cut rectangular masks from black paper or use regular masks of material such as red Kodaloid. The masking provides for a white margin on the print.

The darkroom may be illuminated by means of a yellow safelight, as, for example, the Wratten OA, for printing work.

1. Place the negative in the printing frame or on the printer, emulsion side up.

2. Mask the negative by means of the metal masking strips or cutout masks.

3. Place the printing paper (chloride paper), emulsion side down, against the negative emulsion.

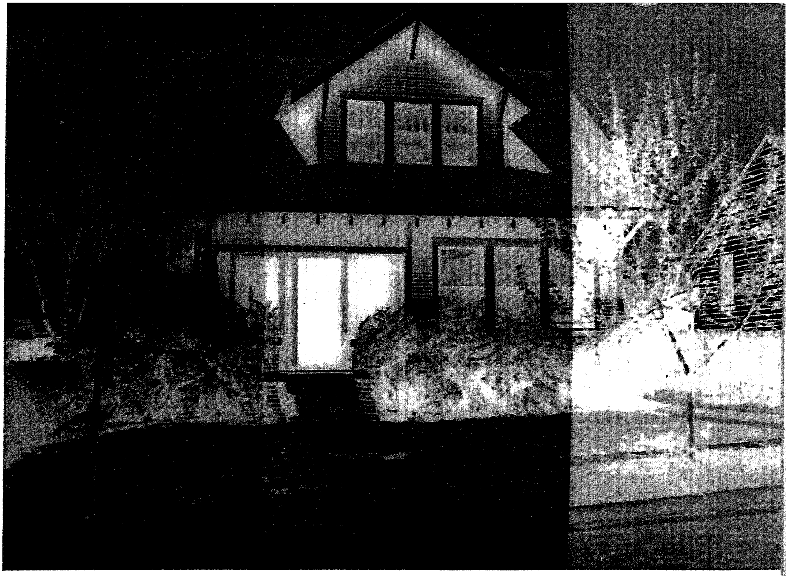
4. Close the frame, turn it over, and turn on the light. With a normal contrast paper on a negative of normal density, using a 50-watt light bulb in reflector about 18 inches from the frame, the exposure will be from 5 to 10 seconds. You will quickly learn the necessary exposure to give, which depends upon the density of the negative, and the degree of contrast of the paper (see below). In using the printer, the top pressure plates, when clamped down on the paper and negative, usually turn on the light automatically. The printer also contains a yellow or ruby light, which is useful in placing the negative on the printer and masking it. If you are handy with tools, you can build a printing box for yourself. Dense negatives require either longer exposure, a brighter light, or the light closer to the frame.

5. Remove the paper from the printer or frame. It is now ready for developing.

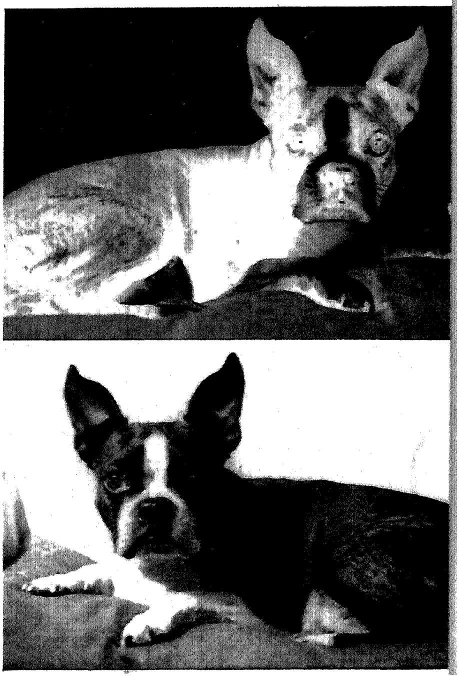
Processing.—The processing layout is as usual, with three trays: one for developer, one for short-stop, and one for hypo. You can use print tongs to handle the prints; if you do, either use different tongs for developer and hypo or rinse the tongs in water before using again in a different solution. Avoid carrying hypo back into the developer. If you do not use tongs (as recommended), rinse or wash the fingers between solutions. A properly exposed print will begin to show the image in 10 to 15 seconds, and will be completely developed in from 45 seconds to 3 minutes. If, at the end of several minutes, the image is faint, the exposure was too short. On the other hand, if the image snaps up quickly, the exposure has been too long. Most photographers agree that a print should be exposed long enough so that development will require from 45 seconds to 1½ minutes. (For developer formulas see Laboratory Manual.) Illustration 25 shows the effect of under- and overexposure. Nearly the same effect can be obtained by under- or overdevelopment.

The print is next immersed in the short-stop for a few seconds, and then transferred to the hypo. Here it should fix for about 10 to 15 minutes with occasional agitation, and should then wash for about an hour. The washing may be done with running water in trays, pans, or tubs, as in the case of film. There are specially built print washers that wash prints thoroughly and in fairly short time. There are also tests that can be given the prints to determine when they are free from hypo (see Laboratory Manual).

The drying of prints differs somewhat from that of film. The print, after washing, should be placed on a flat glass and squeegeed with either a rubber roller or a regular squeegee, which consists of a heavy strip of rubber set in a wooden handle. The purpose of this operation is to remove as much water as possible from the print. The print may then be dried between flat lintless blotters or placed in blotter rolls, which are simply long sheets of muslin-surfaced paper on which the prints are laid face down and covered with a blotter sheet. The backing of blotter rolls is usually corrugated cardboard. The roll curls the prints *away* from the emulsion, because the normal tendency of a print is to curl toward the emulsion. Prints dried in the roll, therefore, come out fairly flat after 10 to 20 hours.



23. (*Above*). Overexposed, Normally Exposed, and Underexposed Negative.
Left to right: 1/15 sec.; 1/60 sec.; 1/200 sec.
24. (*Right*). Negative and Positive.



25. (*Top*). Underexposed, Normally Exposed, and Overexposed Print.
26. (*Above*). Normal Negative Printed on Three Contrasts. *Left to Right: No. 0, No. 2, No. 5.*
27. (*Left*). Prints from Flat and Hard Sections of Negative Shown in Illustration 23.

Prints dried between flat blotters may need to be slightly moistened *on the backs* and redried under some pressure. Running prints through wringers helps to straighten them, or they may be run around a typewriter roller. Professional finishing plants, of course, have straightening machines, and large electrically heated drying machines as well.

Glossy prints (prints made on glossy surfaced paper) need to be dried on what are called ferrotype tins. These are rectangular sheets of tin, of various sizes, with either black or chrome finish. The black tins require occasional waxing and polishing which the chrome tins do not, though the latter type cost considerably more than the others. Glossy prints are squeegeed onto the ferrotype tins and left to dry. These prints, too, frequently need to be straightened after drying.

If prints, both glossy and velvet, are soaked for 5 or 10 minutes in Agfa's Flexogloss solution, before drying or ferrotyping, they will remain more nearly flat when dry. This treatment is especially good for glossy prints.

Spotting.—It often happens that small particles of dust on the glass in the printing frame will make tiny "holes" in the print. These can be filled in by using a medium-soft pencil sanded down to a fine point, or by either black-or-white spotting inks or a mixture of both, using a small brush. Be sure to match the shade if using inks. This work of spotting is really retouching, and the retouching of prints, as the retouching of negatives, is an art in itself. On prints, for example, it is possible to remove facial defects, accentuate features, or create or remove highlights and shadows. Some of this type of work is discussed in connection with the paper-negative technique, see page 231. Spotting is used more for enlargements than for contact prints (see next chapter).

Trimming.—The print, when dry, may be trimmed, and for this purpose a photo trimming board is needed. Most trimming boards are marked off in ½-in. squares both vertically and horizontally and have an inch ruler across the top. The steel knives are self-sharpening, as they cut against metal plates. One type of trimming board uses a detachable transparent trimming guide, with lines at dif-

ferent distances from the cutting edge, so that prints may be trimmed with margins of various widths.

Mounting.—Contact prints may be mounted on pieces of cardboard for use in frames, though contact prints made from negatives of the sizes in commonest use are more often simply mounted in albums. (For directions for mounting on display mounts see Chapter XV.) For mounting in photograph albums you may use glue, paste, or dry mounting tissues or membranes. The latter are "thermoplastic," requiring heat to make them stick, and are used the size of the print. Take a piece of the tissue, place it under the print and pass a hot iron quickly across the surface of the print. This heat causes the tissue to adhere to the back of the print. Then place print and tissue in the album or on the mount and apply the heated iron over the surface to stick the tissue. Special irons are available for this work.

Prints can be mounted in albums by the use of gummed corners which stick to the album page, into which the print may be inserted. Such corners are available in a number of colors. Another method of mounting prints is by the use of double-gummed stickers. One side of the sticker is moistened and fastened to the print and the other side is then moistened and fastened to the album page. Loose-leaf albums may be made by using sheets of heavy, dark-colored paper with holes punched in one edge, by means of which the pages may be fastened together or into a heavier cover by shoelaces or ribbon.

CHOICE OF PAPER

On the choice of paper depends the appearance of the print. Here you have the chance to correct a faulty negative by choosing a degree of contrast to fit the negative. Most papers for contact printing come in from 4 to 6 degrees of contrast ranging from No. 0 to No. 5. The low numbers are "soft" and are used on contrasty negatives. On the other hand, the higher numbers are contrasty papers and used for negatives that are quite flat and have lack of contrast. Papers that are furnished in 6 contrasts should be used as follows:

No. 0—For excessively contrasty negatives
No. 1—For extreme contrast negatives
No. 2—For average negatives
No. 3—For flat negatives
No. 4—For extremely flat negatives
No. 5—For excessively thin or flat negatives

If you choose a contrasty paper to print a contrasty negative you will have empty highlights or blocked shadows, as you thus sacrifice part of the scale of grays and run too much to blacks and whites. If, on the other hand, you use a soft paper to print a soft negative you will have only a gray or flat print.

Besides selecting the contrast of paper to fit the negative you may use the different papers to secure desired effects. For example, you may have a normal negative, and yet prefer to print it soft. Illustration 26 shows the use of different contrast papers on a normal negative (left to right: No. 0, No. 2, No. 5). Refer again to Illus. 23. The three sections of this negative (left to right) might be referred to as hard, medium, and flat. For printing, these sections require, respectively, No. 0, No. 1, and No. 3 paper, and prints from them are shown in Illus. 27 (reversed in position, the No. 3 being at the left).

Do not confuse contrast with density. Contrast determines the degree of contrast paper to use, whereas density affects the time of exposure necessary for printing. A dense negative will require longer exposure than a thin negative.

An overexposed print can be corrected by underdevelopment or an underexposed print can be forced in the development, though usually you will secure yellow stains if you develop too long. As we have said before, for best results use an exposure that will require about 45 seconds of development.

Surfaces.—Most papers, besides being available in two weights (single and double), are available in numerous surfaces. Most kinds of papers, for both contact printing and enlarging, include a glossy surface. It is unfortunate that manufacturers give their papers so many different names, as, for example, Royal, Kashmir, Tapestry,

Silk. It is enough for the beginner to try to learn the makes of papers, without having to learn the names of surfaces. Papers that are not glossy may run down to the dull (no gloss), through such stages as semigloss, luster, semimatte, and matte. Some of the colors are natural white, cream white, old ivory, ivory or white. Some of the Eastman papers are Vitava Athena, Vitava Opal, Kodabrom, and P.M.C. Bromide projection papers (see next chapter), or Azo and Velox contact papers. As an example of the various kinds of papers that can be purchased of one particular name, Azo papers are made in the following surfaces and contrasts, usually known by the letters prefixed to the list:

Single weight

A—Smooth, matte, white, No. 2
C—Smooth, glossy, pensé, Nos. 0, 1, 2, 3, 4, 5
E—Smooth, semimatte, white, Nos. 0, 1, 2, 3, 4, 5
F—Smooth, glossy, white, Nos. 0, 1, 2, 3, 4, 5
K—Smooth, semimatte, cream white, Nos. 2, 3, 4

Double weight

A—Smooth, matte, white, Nos. 1, 2
AA—Smooth, luster, cream white, Nos. 1, 2
B—Smooth, semimatte, cream white, Nos. 1, 2, 3
D—Rough, matte, natural white, Nos. 1, 2
E—Smooth, semimatte, white, Nos. 0, 1, 2, 3, 4, 5
F—Smooth, glossy, white, Nos. 0, 1, 2, 3, 4, 5
G—Fine grain, luster, natural white, Nos. 1, 2, 3, 5
H—Fine grain, matte, natural white, Nos. 1, 2
J—Smooth, luster, old ivory, Nos. 1, 2, 3
L—Rough, luster, natural white, Nos. 1, 2
P—Fine grain, luster, old ivory, Nos. 1, 2, 3, 5
Q—Fine grain, matte, old ivory, Nos. 1, 2
X—Silk, semimatte, old ivory, Nos. 1, 2, 3
Y—Silk, semimatte, cream white, Nos. 1, 2, 3

Azo Postcards

B—Nos. 1, 2, 3
E—Nos. 1, 2, 3, 4
F—Nos. 1, 2, 3, 4
K—Nos. 2, 3

Some Agfa papers are Brovira, Cykora-Cykon, and Convira. For enlarging, I prefer Kodabrom G or Brovira Royal.

PRINTING FAULTS

Difficulty	Cause	Remedy
Print is too light	Underexposed or cold developer	Make new print with more exposure or develop in solution at proper temperature
Print is too dark	Overexposure or developer too warm	Make print with less exposure or use developer at proper temperature
Flat print	Wrong contrast of paper used	Use more contrasty paper
Print too contrasty	Wrong grade of paper	Use softer paper
Print is stained	Developed too long or fixing bath or developer exhausted	Use sufficient exposure to develop normal time and use fresh fixing bath and developer
Gray prints and borders	Old paper, paper fogged by poor safelight in darkroom or developed too long	Use good safelight and expose for proper length of development, or try fresh paper
White deposit on print	Milky hypo bath	Use fresh hypo

SPECIAL FINISHING WORK

Texture Printing.—You can secure a pictorial texture by use of purchased texture screens designed to give an effect of oil painting or etching. Or, you can make your own screens by photographing on a contrasty film a piece of monk's cloth, burlap, or canvas. From the negative make a positive on a contrasty paper. This positive should be the same size as the negative you wish to make into a texture print. You then make the print through the texture screen. You can also use sensitized paper upside down in the printing frame so that the light will pass through the paper before reaching the emulsion, thus showing the texture of the paper itself in the print. Other kinds

of cloth and papers, even a linen handkerchief (see Illus. 28), can be used for texture printing. In any case, choose carefully the subject for texture printing, as many subjects do not lend themselves to this treatment. Portraits are always good.

Silhouettes.—These should be printed on contrasty paper, No. 4 or 5, to obtain extreme contrast between the black and the white.

Distortion.—A distorted print may be made by heating a negative until the emulsion begins to melt. A negative to be used in this manner should be fixed in a plain hypo fixing bath, including no acid hardener. When the negative is heated until the emulsion begins to melt, hang it up to dry. When it has cooled and dried, the emulsion will have run enough to distort the image. Distortion is more easily done in the enlarging process (see next chapter).

Snow and Rain Effects.—These effects are fairly easy to make. Simply take a piece of glass, moisten a toothbrush with show-card whiting, run the thumb along the bristles and as they snap back into place they will spatter the white onto the glass. Use this glass as a printing screen for either contact printing or enlarging. It should be used with the spattered side away from the emulsion so that the small white spots are somewhat diffused on the print. Illustration 29 shows the use of such a screen.

To make a rain scene, run the brush with white paint on it across a clean piece of glass in a diagonal direction. You may have to help it some by rubbing out or thinning to make a natural-looking line.

Cutouts.—You can give "life" to snapshots of persons or animals by mounting them on pasteboard or thin plywood and cutting around the outline with a jig saw or a scroll saw. These may be mounted by gluing into grooves in little flat baseboards. The baseboards should be at least a half inch thick.

Direct Positive Prints.—You have probably seen pictures made in the dime store photographic shops. These are made on what is called direct positive paper. This paper is used in the camera instead of film, though it is slow. It is called direct positive because the paper itself, after the exposure has been made, is developed into a negative, then bleached and redeveloped into a positive. Each piece of

paper makes only one print, as no negative is involved in the process. The processing of direct positive paper is given in the Laboratory Manual.

Printing-out Paper.—If you expose ordinary sensitized paper in contact with a negative, you must develop it to bring up the image. This process is called "developing out." There is a kind of printing paper that may be placed in contact with a negative in a printing frame and *exposed to sunlight,* and left to print itself into the positive image. This kind of paper, available in only one grade of contrast, requires no developing, only fixing in a hypo bath. This paper is used for proofs by many photographers. In making the print the paper may be placed with the emulsion side toward the back of the printing frame, so that one side of the frame may be opened from time to time to see how the printing is coming along.

Tinting.—Many photographers feel that tinting spoils a picture, and all salons and most exhibitions will not accept *hand-colored* pictures. However, for home use, most photographs can be colored. Probably the easiest to color are landscapes or seascapes, and interior pictures and portraits are probably the hardest.

For water colors you can secure boxes of 12 colors, which may be dissolved in water or used by touching a wet brush to them. Prints should be held flat while coloring. Those with more grays than deep blacks are best, and they should be of at least medium contrast. Glossy surfaces are difficult to color. Colors can be mixed to make other tints.

The color set contains complete instructions for use. The chief things to remember are:

Work in daylight if possible.

Use weak or diluted colors, applying several coats if necessary.

If the surface of the print will not "take" the color it may be moistened with a weak ammonia solution by means of a cotton swab and then moistened with plain water.

Keep the print moist but not so moist as to permit it to buckle.

Use strong colors for foreground objects and weak colors for background objects.

Transparent Oil Colors.—These can be purchased in about 15 colors, with instruction book, sizing fluid, cleaning fluid, thinner, and cotton. As in the case of water colors, the oils are best used on matte or semimatte papers. Most of the work is done with cotton, a small tuft wrapped on a skewer. Excess color can be wiped away with clean, dry cotton. This wiping should be toward the center of the area colored. The prints are coated with a medium before tinting, and the medium may be used to remove color, provided only it has not dried. All prints to be colored should be free from hypo.

Toning.—The early printing process usually made prints in shades of purple or brown, and these shades became so familiar to the public that when the black-and-white prints came into use they were scarcely recognizable as photographs at all. Consequently, the public demanded a method of turning the black images into brown or sepia, and this process—toning—now includes not only sepia, but gold and other colors as well. The operation of toning includes simply the transformation of the silver image into another color, either by replacing the silver or by transforming the silver image into another substance that has a different color.

Sepia tones are made by converting the silver image into silver bromide and then converting the latter into silver sulphide by treatment with a solution containing sulphur in a free form. The sulphide is then deposited in place of the silver bromide. This process includes a preliminary bleach that turns the black silver image into a yellowish-white image of silver bromide, the image being scarcely visible, followed by the treatment with the sodium sulphide.

Other toners include blue, green, yellow, brown, and gold. Only the sepia requires the preliminary bleaching process. The others are used simply as "toning baths." Formulas for toning will be found in the Laboratory Manual.

Prints can be toned in several colors by protecting portions not being toned by an especially prepared varnish, or Canada balsam. For example, cover the sky portion of a print with varnish while you tone the landscape or foreground with sepia or brown toner. Then

remove the varnish from the sky, varnish the sepia-toned portion, and use the blue toner on the sky. The process can be used for any toning color, but be sure to cover with varnish all portions of the print *except* those to be toned. For this particular process there are special toners, made by Burroughs, Wellcome & Company.

Chapter XV

ENLARGING

The Process of Enlarging.—An enlargement is a positive made from a negative, not by direct contact, but by passing rays of light through a negative and lens to record on sensitized bromide paper. This paper, after the usual processing, is an enlarged image, and the size of the enlargement depends on the distance between the lens and the paper. The enlarging instrument is, therefore, much like a lantern-slide projector or is a camera with a light back of it. If you have a bellows camera you can build your own enlarger by making a lamp house to attach to the back of the camera. This can be done more easily if you have a view camera as the grooves into which the ground-glass or film holders fit make it easier to attach or remove the camera from a lamp house.

Special enlarger bulbs are made for the purpose, or you may use small photoflood bulbs. In using the photoflood bulb, it is a good plan to have it wired through a resistance coil (such as a 600-watt heating unit), with a double switch so that the light need not always be used at full intensity. The small-size photoflood bulb, with a life of only two hours at full power, can be given the more nearly normal existence of many hundreds of hours if the current passes through the resistance unit, though the light will not be nearly so bright. Enlarging, of course, must be done in the darkroom, and the yellow safelight is suitable even for fast bromide papers if it is a dependable safelight, such as the Wratten OA.

Types of Enlargers.—Many enlargers are of a type called auto-

focus. That is, as the enlarger is raised or lowered the image is kept in focus by an automatic device that moves the lens nearer to or farther from the negative. Figure 50 shows the two types of enlargers. Type A shows the light source in a reflector which throws the rays of light onto a diffusing glass, which may be opal or ground glass. This diffusing glass throws the rays of light in all directions through the negative, casting the image on the easel

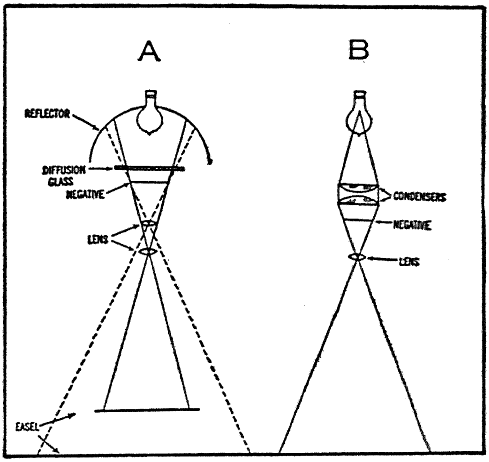


Fig. 50. Enlarger Diagrams

below. The easel may be one specially built by a manufacturer for this purpose, including masking guides so that enlargements can have white borders, or you can make an easel for yourself by using a sheet of glass on top of a large board, such as a breadboard or a drawing board. The farther the enlarger is from the easel carrying the sensitized paper the greater will be the enlargement, and the closer to the negative will be the lens to make a sharp focus. This is diagramed in Fig. 50-A, in which the dotted lines show the lens closer to the negative.

The other type of enlarger is that using one or two condensing lenses (see diagram, Fig. 50-B). In this type, without special reflectors back of the lamp, the condensers must be large enough to

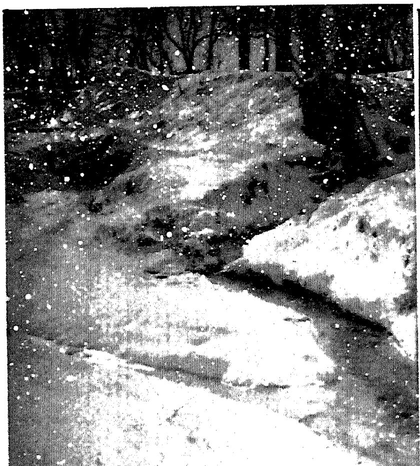
cover the entire negative. The condenser enlarger makes clearer projection prints, but will show up any irregularities or scratches on the negative.

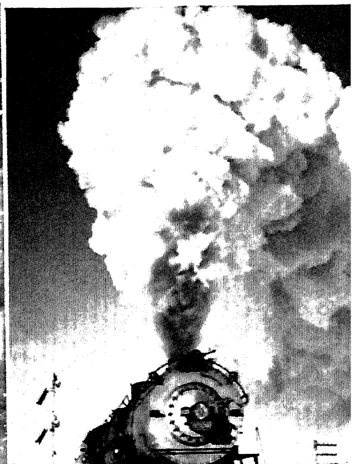
The enlarger must be built so that it may be raised or lowered. Some enlargers are built so that they may be slipped up or down on an upright post; others are mounted on parallel arms so that they swing in the arc of a circle from the wall, and these are usually counterbalanced by weights attached to a cord running over pulleys. Enlargers may also operate in the horizontal position, though most photographers prefer vertical enlarging chiefly because the focus can be examined more easily. If you build your own enlarger, place condenser or a diffusing glass at least an inch from the negative so that its own image will not show on the print, and test critically the reflector for the point at which it focuses, so that you can place it at that distance from the negative. In this connection it is best simply to hang the reflector over the bulb so that the bulb is as far at the back of the reflector as possible. The lamp house must have a tray to hold the negative and the whole should be as light-tight as possible. Remember, too, that it should be equipped for ventilation, so that air may pass over the surface of the negative, up through the lamp house, and out through a light trap. Otherwise the heat will cause the negative to curl and buckle.

HOW AN ENLARGEMENT IS MADE

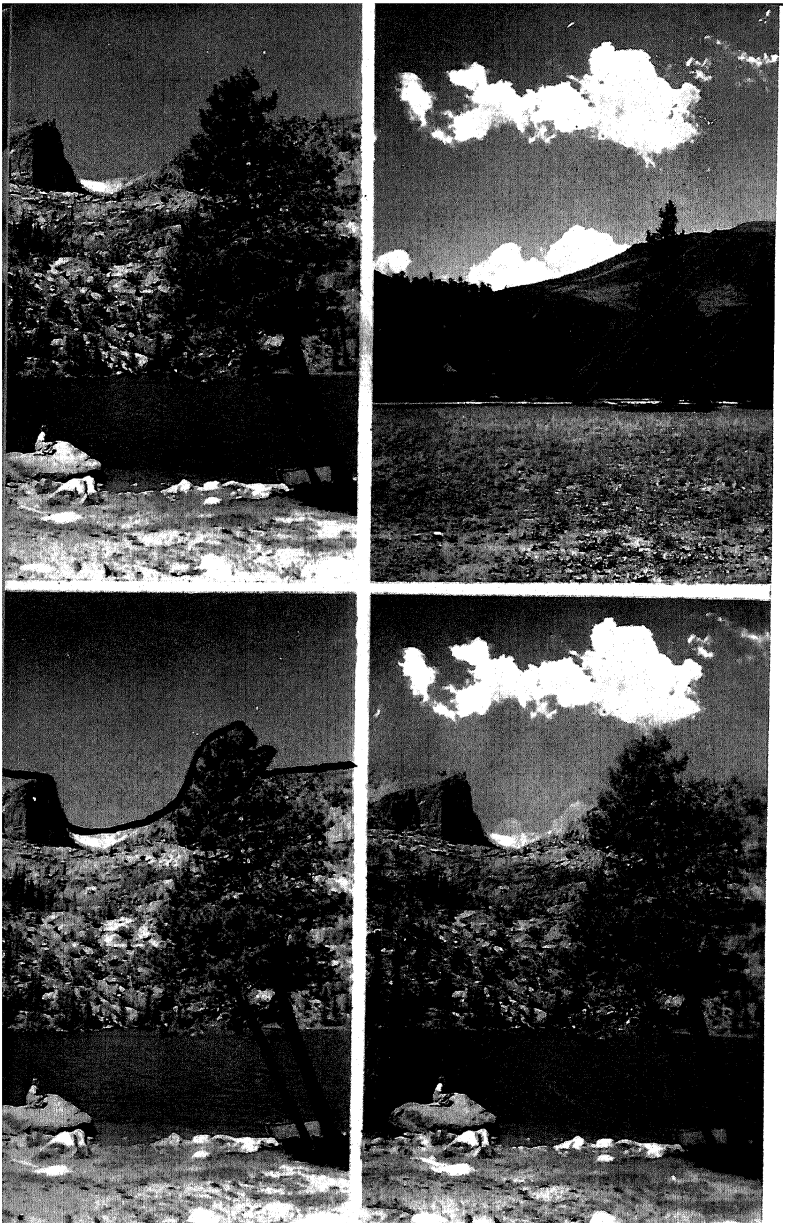
Focusing.—First of all, see to it that all equipment is clean. The thin sheets of glass between which the negative is placed must be entirely free from dust, or the dust particles will show on the print. If using a homemade easel, with a sheet of glass holding down the sensitized paper, this glass also must be clean. So must the lens. The negative must be placed in the enlarger *emulsion side down*, that is, so that the emulsion side of the negative faces the emulsion side of the sensitized paper on the easel. Otherwise the picture will be reversed.

With the negative in place in the enlarger, move the enlarger itself to the proper distance from the paper to secure the enlarge-





28. (*Above*). TEXTURE PRINT.
29. (*Lower Left*). SNOW EFFECT PRINT.
30. (*Lower Right*). SEVEN DIAMETER ENLARGEMENT. *Photograph by Claude Pilger.*
Leica Camera, Supreme film, Leitz No. 3 yellow filter, 1/1000 sec., f:4.5.



31. Printing-in Clouds.

ment desired. In connection with the size of the enlargement there are some things to remember. First of all, the focal length of the lens is an important factor, though it is possible to make gigantic enlargements with almost any lens, because the larger the projected image the closer the lens approaches the negative. However, the distance the enlarger can be placed from the easel and the focal length of the enlarging lens work together to determine the size of enlargement that can be made. Consequently, if working with miniature negatives, the enlarger should have a lens of short focal length so that you can make large projection prints with a comparatively short distance between lens and easel. Special enlargers are built for miniature work.

Enlargement sizes are generally spoken of as "diameters" of enlargement. If the negative is 3 x 4 in., a two-diameter enlargement will be 6 x 8, just twice the length of either dimension. A three-diameter enlargement would be 9 x 12 in., etc. Of course, either dimension of the negative or its diagonal will increase in the same proportion (see Illus. 30).

With the enlarger at the proper distance from the easel, bring the image into a sharp focus by examining the projected image on the easel. A sheet of white paper on the easel assists this operation, and a small hand lens also helps. There are numerous other devices on the market for securing sharp focus in making enlargements.

With the operation of focusing comes the matter of composition. It seldom happens that you will want to enlarge the entire negative. Usually a portion of the negative will make a better composition for the finished picture; also, there may be portions of the original negative not wanted in the projection print. With the image of the entire negative projected onto the easel, examine it by means of L-shaped masks or by use of the sliding masking arms to determine the portion that will make the best picture. This portion must then be brought to the proper size by raising or lowering the enlarger. Then mask the easel either by a cutout mask placed under the glass on a homemade easel or by moving the masking guides on an easel so equipped. This process is known as "cropping." The

focusing should be done with the lens at full aperture in order to have ample illumination of the projected image.

Exposure.—The greater the diameter of the enlargement the longer the exposure will need to be. As it is difficult to estimate the exposure time necessary for the first enlargement made from the particular negative, it is best to make a "test strip." This avoids wasting paper. Take a small strip of the paper you intend to use, a piece the length or width of the sheet and from 1 to 2 inches wide. Place this on the easel and over the most important part of the picture, emulsion side up. After focusing with the lens wide open, stop it down to f:8 or f:11 to ensure proper definition and sharpness (miniature enlargers use f:5.6 or f:6.3). Next turn on the enlarger light and expose the whole strip for 5 seconds. After 5 seconds cover a portion of the strip and expose for 5 more seconds, cover a bit more of the strip and let the exposure go on for 10 more seconds. Again move the covering mask up a little and expose the balance of the strip 20 seconds longer. This will give a test strip of 4 sections, exposed for 5, 10, 20, and 40 seconds, respectively. One of these should be the proper exposure for making this enlargement. You will soon learn the length of time to give exposure strips, for different papers and for different negative densities. If the first test strip does not indicate clearly what the exposure should be, make another, running, perhaps, to 80 seconds. Sometimes you will want to expose 5, 10, 15, and 20 seconds, sometimes 10, 20, 30, and 40 seconds, though many photographers feel that the best method of making exposure strips is to double the exposure each time. The best exposure test strip is one that shows a good "step-wedge," running from very light to very dark.

With the proper exposure determined, make a print on a full sheet of paper. The exposure should be long enough so that the print will require from 1½ to 3 minutes of development.

Control.—The first enlarged print made will indicate what sort of "control" should be exercised. The most important method of control is called "dodging." The dodging process is done simply by cutting off the light from a certain area of the picture being made in

enlargement, so that less light will reach this area and it will consequently print lighter. This can be accomplished by small cardboards fastened on the ends of wires which can be held under the enlarger lens so as to cover the portion it is desired to print lighter (see Fig. 51). The dodger should be moved in a slightly circular motion so that its outline will not become part of the print, and experience will show how much dodging is necessary. Allow the light to act on the whole picture for a long enough time to print

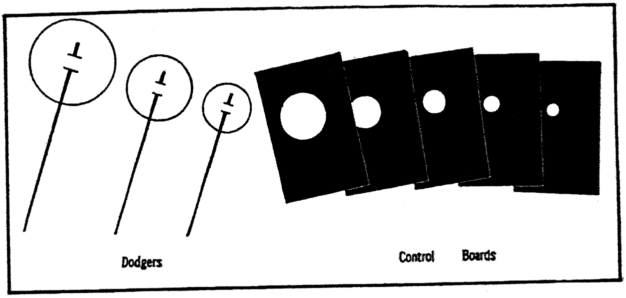


FIG. 51. DODGING AND CONTROL DEVICES

the dark tones and then hold the dodger so that it prevents the light from reaching the portion of the picture that has already been fully recorded. Instead of using pieces of cardboard cut into circles about ½ or 1 inch in diameter you may sometimes want to cut out special masks to use as dodging instruments. The fist can serve as a dodging device, too.

Other Control Devices.—Other control devices can be pieces of black cardboard with round holes cut in them (see Fig. 51). These control boards, when held under the lens, prevent the light from striking all the easel *except* the circle, and are used to secure increased exposure on portions of the picture that need it, at the same time shielding the rest of the picture from further exposure.

Some additional control can be exercised in the developing, partly by the choice of the developer but chiefly by the dilution. A developer diluted with two parts water is faster in action than one diluted

with three parts water, and the latter will slow up the developing time so that you may remove the print from the developing solution when it has come up to the desired tone. Some photographers even go so far as to paint developer on their enlargements with brushes, to secure the degree of development desired for each portion of the print. By this process just about anything is possible, though skill and practice are required. Control of contrast is handled by the choice of paper exactly as in contact printing. A fairly soft negative is better for enlarging purposes owing to the fact that enlargements usually show greater contrast than do contact prints.

Finishing.—The processing of enlargements—development, short-stop, fixing, washing, drying—is the same as for contact prints. Slide the print face up into the developer from one side of the tray. Agitate the developer and turn the print face down. Continue the agitation and examine the print every 10 or 20 seconds. Toning or tinting also is done the same way as for contact prints. Mounting, however, in the case of projection prints, involves the use of large sheets of cardboard, 16 x 20 in. (standard), on which enlargements may be displayed in exhibits or salons. Many photographers agree that enlarged prints should be judged only on mounts, on the theory that the mounts bring out or show up both the good points and the faults of the prints. The mounts are usually white or light gray and quite heavy.

An enlargement to be mounted for exhibition should be trimmed so that there is no white margin showing. The finished print does not have to contain all of the picture that was printed on the paper; some additional cropping (in this case, simple trimming) may be needed. In placing the print on the mount, have equal margins at left and right, with equal or slightly greater top margin. The bottom margin, in any event, should be at least one-fourth wider than the side margins. It is best to measure the side and top margins with a ruler, though the eye can help some.

When the print is arranged on the mount in the desired position, mark the corners lightly with pencil. The print may be fastened to the mount in one of several ways. Glue or paste may be used,

though a better method is to use paper cement, placing the cement on the back of the print *and* on the mount as well for permanent mounting, but on the back of the print only for temporary mounting. The print is placed on the mount and pressed down firmly, using squeegee, roller, or cloth. Cement extending beyond the edges may be brushed or rubbed off without injuring or marking either the print or the mount. The dry mounting method discussed in the previous chapter may also be used.

There are variations from ordinary mounting. For example, double or triple mounting may be done when needed or when improvement can be had by so doing. A light-colored print, or one with a light background, may first be mounted on a sheet of darker paper extending beyond the edges of the print, and the whole may then be fastened to the mount. This prevents the background from blending into the mount itself. Also, some photographers like to draw lines around mounted prints, or around two of the corners, though this method is not suitable for all prints.

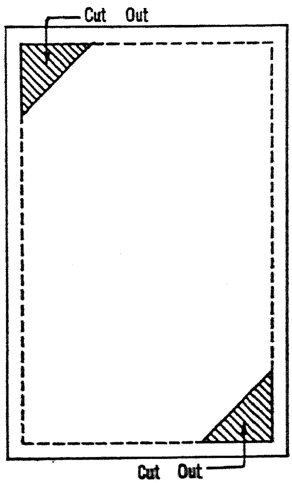


FIG. 52. EMBOSSING FORM

Plate-sinking also is done, a process sometimes spoken of as embossing. In this process, an embossing form is made, on heavy cardboard about ¾ inch wider and 1 inch longer than the print itself. The form allows for a margin of ⅜ inch on each side and at top of the print, with ⅝ at the bottom. Two of the corners are cut out, as shown in Fig. 52. This form is placed on top of the mounted print, with the corners located through the openings cut in the form, and mount and embossing form are carefully turned over so that the back of the mount is uppermost. Hold it firmly and run either embossing tool, orangewood stick, or blunt instrument around the edge of the embossing form. The pressure of the

embossing tool should be even, and the result will be a plate-sunk effect around the print itself. The same procedure can be used to emboss a wide-margin enlargement, except that in this case the embossing form should be of the same thickness as the print; the embossing can be done on top of a glass desk, lighted from beneath so that the wide-margin enlargement can be located over the embossing form.

Enlargements may be made into albums by mounting them back to back. Pieces of cloth tape may be mounted between the binding edge with an extension permitting holes to be punched for lacing. Still another method is to have enlargements mounted back to back and placed in plastic binding. This type of binding can be secured at small cost from any bookbinder possessing the necessary plastic work equipment. This and the loose-leaf method give the opportunity to make up albums on particular subjects, with pictures in consecutive order.

SPECIAL PROJECTION PROCESSES

Distortion.—This process is used not only "just for fun," but to correct distortion in negatives as well, and it can be used to achieve serious effects. Distortion in the enlarging process can be done simply by tilting the easel, by folding the paper so that it does not lie flat, or by focusing the enlarger lamp so that part of the print is not in focus. These methods may be used singly or all at once. It is best to use a piece of white paper on the easel so that the effect may be viewed before making the actual print. Some photographers use for this purpose an easel fastened to a swivel joint.

Focus for the middle height, and stop down the lens far enough so that the entire image comes into focus. If it is difficult to see the projected image with the lens stopped down, you may have to turn off your safelight. Negatives for distortion should be fairly thin because the process requires a rather long exposure. Use a contrasty paper—the process has a tendency toward flatness. Many different effects can be obtained by buckling the paper, as this method distorts only portions of the print.

Texture.—Texture prints can be made in enlarging as easily as in contact printing. Silk makes a good texture screen. If the silk is stretched on a frame, and used in contact with the paper, the enlargement appears to have been made on cloth. If the screen is placed above the paper diffusion is secured. Negatives for texture prints should have more than average contrast.

As in contact printing, a screen effect can be produced by printing through the back of the sensitized paper. This incorporates the texture of the paper itself in the printed image. The use of a texture screen will increase the exposure by about one-half.

Photomurals.—A photomural is simply a huge enlargement used as a wall decoration. It is not difficult to make such murals, though the cost of paper makes it fairly expensive. Printing papers can be obtained in rolls either 40 inches or 6 feet wide.

There are two methods of making a mural, and the method used depends on (1) whether your enlarger can be used in horizontal position or (2) how many diameters enlargement it will produce. The first method makes the whole mural in one shot. The second method makes it in sections.

In using the first method mount the enlarger so that it will project the image across a room. You must know in advance the exact size of the picture you are going to make; then place your enlarger far enough from a light wall or screen for the focused image to be the desired size. Mark the corners with scotch tape. Run a test strip, and mount the enlarging paper securely to the wall, entirely flat. This, too, may be done with scotch tape. The development requires a tray large enough to do the job, which may be made by placing a large sheet of oilcloth with the edges held off the floor. It requires a lot of developer to immerse the entire enlargement at once. An alternate method is to swab the print with developer on a large wad of cotton. By this method you can stop development of each portion at the point you wish. It is best to have several assistants working at once, and other assistants can follow up with the short-stop. For fixing, however, the print should be immersed in a fixing bath. If you make the single tray do for all

solutions, each solution should be well mopped before adding the next, and the fixing solution should be thoroughly washed from the tray before developing the next print.

The second method involves the enlarging of portions of a negative to the number of diameters the enlarger permits. The negative must be accurately marked off into its sections, and care taken that the enlargements are all the same size, and especially that they are all developed the same amount. Before hanging these prints they must be trimmed to match, allowing a half inch for overlap, and beveling the edges to avoid making a heavy seam.

Photomurals should be made on single-weight paper and hung as ordinary wallpaper. The wall should first be sized with wall conditioner and ordinary wallpaper paste should be used. It may be advisable to paste up muslin cloth to serve as a base. Photomurals are hung wet and the stretching of the paper must be allowed for, as it amounts to 1 inch in every 35. Wipe the extra water from the back of the print just before coating with cold-water paste. After the muslin is hung it should be sprayed with a transparent flat-drying lacquer.

Chapter XVI

THE DARKROOM

To do finishing work a darkroom is a necessity. This is simply a room from which all light has been excluded. It may be a kitchen or bathroom or other room in the house, or it may be a specially built photographic laboratory. To use a kitchen or bathroom the chief problem will be the exclusion of light. Windows can be made light-tight by placing tight-fitting pieces of corrugated cardboard over the glass, and, for greater protection, sealing them with scotch tape. Another way is to cover the window, frame and all, with heavy black paper, such as tar paper, and seal the edges with scotch tape. Light must be prevented from coming around the edges of the door. This will require the use of felt stripping or other material to make a light-tight joint. The room can be used at night, of course, simply by pulling down the shades. Supplement the shades by blankets or other cloth material if there are bright street lights outside the window.

If you are building a darkroom from scratch your problem is really somewhat simple, because it can be built with the intention of making it perfectly dark. The location of the room is of some importance. For example, if you will have to go up or down several flights of stairs it becomes inconvenient. Moreover, there is the problem of bringing water to the room and the disposal of waste water. There is also the problem of the temperature. In winter you may have to make some provision for heating the room, and in summer some provision for cooling it. It is true that the chemical solutions

can be kept at uniform temperature by placing the trays in larger trays of warm or cold water as needed.

A dry basement is the best location. In the basement it is usually easy to connect with the water supply, either cold water or both hot and cold, and drains are accessible. The temperature is fairly uniform the year around. Dampness must be avoided or both films and papers will deteriorate.

Figure 53 shows the floor plan of a small but well-arranged darkroom. This is a basement room, heated by tapping a hot-air pipe with a 6-in. pipe leading to a box at one side of the room about 5 feet from the floor. In this box is an ordinary electric fan which forces hot air into the room in cold weather, and can be reversed in position to serve as an exhaust fan in summer. This room is 7 x 9 and permits two or even three persons to work at one time. The arrangement includes two worktables, one of standard table height so that work may be done in a sitting position. The other work space is higher, 38 inches from the floor. The sink should, perhaps, be larger. It has a wooden grille in the bottom so that trays may be placed on it in level position.

Any variation on this plan will serve, though the amount and kind of darkroom work will have to determine not only the size and arrangement of your darkroom, but also the equipment and amount of space for its storage. The simplest layout must include enough work space, one or more safelights, shelves or racks for storage of trays and chemicals, space for enlarger, and equipment for washing film and prints.

GENERAL EQUIPMENT

There are some things that may be said about the general equipment of the darkroom. In the first place, adequate safelights are necessities. They can be purchased either separately or already mounted in safelight boxes, usually metal, containing light sockets. The safelights should be of two kinds: (1) ruby, such as the series 2 Wratten safelight, with a small light bulb, perhaps 10 watt, for

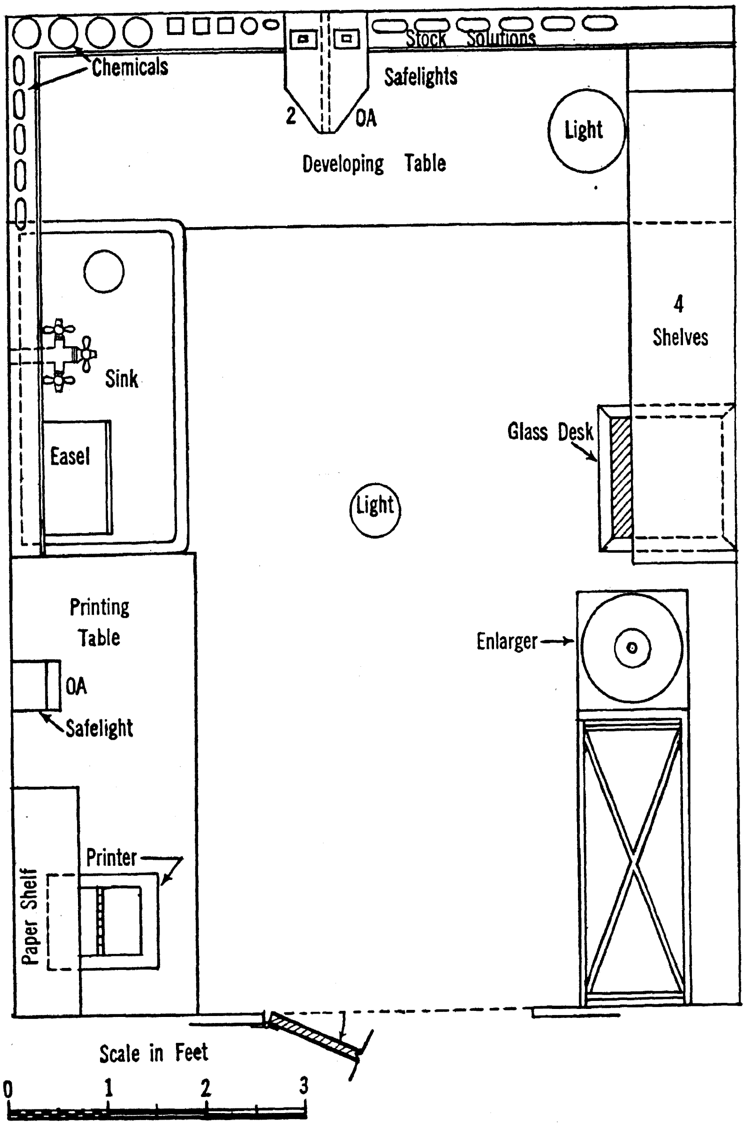


FIG. 53. DARKROOM FLOOR PLAN

use in handling orthochrome or slower films; (2) yellow, such as the Wratten series OA, which is safe for most papers. In any case the safelight must be actually "safe." It is not advisable to buy yellow or orange paper (the so-called post-office paper), as such papers are not specifically prepared for filtering out from the light source all the actinic rays—those that can affect photographic films, plates, or papers. It is economy in the long run to purchase specially prepared safelights as they actually prevent the spoiling of much film and paper.

The safelight may be tested by covering half of a sheet of projection paper and exposing the other half to the safelight for several minutes at 18 inches from the light. Develop the paper. If both halves are still white, the light is safe. If you do not purchase the safelight box, you may buy the filter itself and place it in a home-made mounting. This box may be built of wood, rectangular in shape, with the safelight either on the bottom or on the side, with a light socket at the back, and a switch on either top or side.

If you are orderly you cannot have too many shelves; too few shelves will soon become cluttered. Everything that can be hung up should be hung to the walls or under the shelves. It is helpful to build cabinets to hold small pieces of equipment, tools or paper and film. Such cabinets are useful for holding retouching and spotting equipment and the various attachments and masks for the enlarger. Chemicals should all stand on shelves, open or in cabinets, and they should be handy to the scales and space provided for the mixing of solutions.

Since many types of darkroom equipment include the use of electricity, a number of electrical outlets should be placed around the room where they will be most useful. The sink should have both hot and cold water if possible, and do not forget that a drain pipe for ½-in. intake faucets must be pipe of at least 1¼-in. diameter. If you do not wish to purchase an iron or enameled sink you can build one of wood, coating it with some waterproof and acidproof paint such as Probus, Kodacoat, or Oxygenated Asphalt. The boards

may even be covered with rubber sheeting. The sink should be at least 3 feet above the floor and big enough to hold several trays.

Other general darkroom equipment includes cords or wires for drying negatives or prints, and a latch or lock on the *inside* of the door to prevent interruption. The walls of the darkroom need not be dark in color; they may even be white, if the room can be made perfectly dark.

EQUIPMENT FOR DEVELOPING

For development of film the following equipment is needed:

Trays or Tanks.—These should be made of enameled steel, stainless steel, hard rubber, or bakelite. If trays are used, you need three: one for developer, one for short-stop (for roll film), and one for hypo. A fourth tray may be used, if desired, for wetting the film before development. In the case of roll film, of course, the roll must be moistened with water so that it may be handled in trays. This preliminary wetting is not done if a roll-film tank is used. There is a special tray made for developing roll film. This tray has a rod across the bottom, which keeps the film immersed in the solution. If a developing tank is used, for either roll or cut film one tank may be used for all the processes, or you may have three separate tanks or one tank in three sections. Open tanks or trays must be used in darkness, but roll-film tanks or tanks with light-tight covers may be used in daylight or artificial light.

Thermometer.—This should have a scale at least from 40° to 125° F. There are several types of thermometers for photographic work; any one will do. The long-rod type of thermometer with large flat dial on the end is especially good.

Clock or Interval Timer.—An ordinary clock, or even a watch, can be used for timing development of film in closed tanks, and may even be used with open trays or tanks by viewing its face by means of a soft and carefully shaded red light. For this purpose you can place a piece of red gelatin in an ordinary flashlight. How-

ever, for development (especially of panchromatic materials) in open tanks or trays it is much better to have an interval timer. Such clocks may be set for the number of minutes you wish to develop, and at the end of that interval will ring a bell or cause a small buzzer to sound (see Fig. 54).

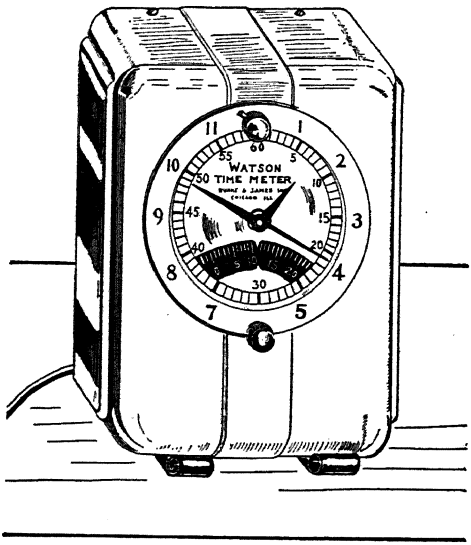


FIG. 54. TIME CLOCK

Film Clips.—For developing roll film by the tray method these may be ordinary pincher clothespins. The regular film clips are somewhat better, as they can be left attached throughout the developing process, and hung on a line for drying the film. For cut film there are special hangers in which the film can be placed or to which the pieces of cut film can be clipped, and kept so throughout the process (refer to Fig. 45).

Washing Device.—Roll film or cut film may be washed in roll-film or cut-film developing tanks or in trays. Place the tank or tray in the sink under the water faucet, and attach to the faucet a rubber tube long enough to reach to the bottom of the tank or tray, to

ensure complete circulation of the water. (See also below, under Equipment for Printing.)

Viscose Sponge or Cotton.—These are used for removing excess water and water bubbles from the film after washing.

EQUIPMENT FOR PRINTING

The equipment for printing includes the following:

Printing Frame.—Such frames are made in numerous sizes. The Kodak automask printing frame is a 5 x 7 frame with sliding metal masking arms, thus permitting the use of negatives of various sizes, from 2¼ x 3¼ (or smaller) up to 5 x 7, and makes prints with white margins. For frames that do not have masking devices you can purchase masking sheets with openings of various sizes, or you can use black masking paper, available in various sizes, and cut the opening to the size desired.

Printer.—A printer, as described and illustrated (Fig. 49) in Chapter XIV, can be made in the home workshop. All that is really required is a box with sockets for light bulbs at the bottom and a printing frame or space to place negative and sensitized paper at the top. Such printers usually diffuse the light by an opal- or ground-glass screen placed an inch or two below the printing position. Most ready-made printers have covers that automatically turn on the light when clamped down over the back of the sensitized paper placed over the negative.

Clock.—This may be any type, even a watch, that has a second hand, as the safelight provides enough illumination for it.

Three Trays as in the Development of Film.—One for developer, one for short-stop, and one for hypo. The trays should be somewhat larger than the paper being developed.

Paddles or Tongs.—The print paddle is a hard-rubber device used for moving prints about in the solutions. Tongs are made of wood, metal, or hard rubber, and are used for handling prints in solutions and moving them from tray to tray. Either have two tongs, one for use in the developer and one for use in the hypo, or

have a dish of water in which the tongs may be immersed before using in a different tray.

Washing Device.—Prints may be washed in trays or in one of the many special print-washing devices. Simple print washers are usually cylindrical containers, built so that the water rushes in at one side and moves with a circular motion once around the washer to an outlet at the bottom. Hypo is heavier than water and must be removed from the bottom. More intricate print washers, used in professional finishing especially, are made as revolving drums which keep the prints in motion throughout the washing. Prints may be washed in trays with water running to the bottom of the tray, or an automatic tray siphon may be used. This device puts fresh water in at the top of the tray, siphons out the waste from the bottom, and may be adjusted to keep the water at any desired level.

Roller or Squeegee.—These are used for removing excess water from the prints before drying.

Ferrotype Tins.—These tins, as described in Chapter XIV, are either black or chrome finish. They are used for drying glossy prints. The black tins must be prepared to prevent the prints from sticking; this can be done by making a solution of 10 grams of paraffin in an ounce of gasoline or benzine. This solution is applied to the tin and polished with a piece of dry flannel.

Blotters or Blotter Roll.—Used for drying prints as described in Chapter XIV.

EQUIPMENT FOR ENLARGING

For enlarging or projection printing you will need the following equipment:

Enlarger.—This device was described in the preceding chapter. Whatever type of enlarger you use should be placed so that its post is opposite the work, that is, on the other side of the easel from you. By this placing there is little danger of the dodging device hitting the post. The enlarger should be on a firm base, and it is best to have the switch regulating the light on a different support, to prevent possible jar. The illumination should be even and can be

made so by the use of the opal- or ground-glass diffusing screen and by the distance from the negative to the light itself. The evenness of the illumination may be checked by moving the light up or down in the lamp house until the field of illumination is even. Photoflood bulbs should be used only in enlargers that are well ventilated.

Easel.—See Chapter XV.

Dodging Devices.—See Chapter XV.

Developing Equipment.—This equipment is the same as for the processing of contact prints, except that the trays must be larger.

LABORATORY EQUIPMENT

For mixing chemicals you need the following:

Laboratory Scale.—Use an accurate scale with beam graduated in both grams and grains, up to 70 grains (see Fig. 55). The scale

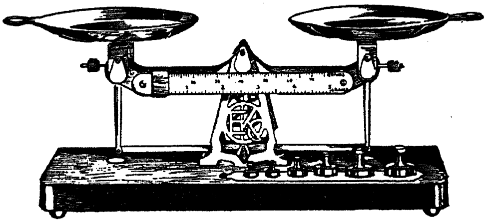


FIG. 55. EASTMAN STUDIO SCALE

should also be furnished with a series of weights such as: 2 oz., 1 oz., ½ oz., ¼ oz., and two 50-grain.

Stirring Rod.—May be hard rubber, glass, or metal.

Measuring Glasses.—These glasses, or graduates, come in various sizes. You should have at least an 8-oz. size, graduated not only in ounces but in milliliters as well. To mix large batches a 16-oz. graduate will be of use, and to perform any photographic operations requiring small amounts of liquids the 1-oz. size, graduated in fractions of the ounce and in drams and cubic centimeters, is of use.

Funnel.—This should be of enameled steel or glass, and the 16-oz. size is best.

Bottles.—Number and sizes as needed.

Developing Sets.—For the beginner there are special developing sets available, as, for example, the Kodak Darkroom Outfit No. 1, which includes:

Brownie safelight lamp (series 2 safelight)
Kodak automask printing frame
2 4 x 6 enameled trays
1 5 x 7 enameled tray
1 8 oz. graduate
Hard-rubber stirring rod
Thermometer
2 Kodak Jr. film clips
6 blotters (9½ x 12 inches)
1 package Eastman MQ developers
1 package Eastman film and plate developers
1 lb. Eastman fixing powder
Instruction book
Copy of *How to Make Good Pictures*

Chapter XVII

SPECIAL DARKROOM WORK

In Chapter XI we discussed special ways in which pictures are *taken*. The present chapter is devoted to special ways in which pictures are *made* in the darkroom. The following topics are the names of special darkroom processes, in addition to special developments (discussed in Chapter XIII) and special printing methods (Chapter XIV), arranged in alphabetical order.

Bromoil.—As this is a pictorial finishing process, it will be discussed in connection with exhibition and salon prints in Chapter XIX.

Combination Printing.—In multiple exposure several shots are made on one film; in combination printing several negatives or parts of negatives are printed on the same piece of sensitized paper. The simplest use of combination printing is to add clouds to a picture.

It often happens that you may secure a good landscape picture when the light conditions are right for the landscape itself, but at a time when there are no clouds in the sky. Your negative file should include some cloud pictures made especially for adding to cloudless landscape pictures. The method of adding the clouds is called "printing in," and is a variety of combination printing. The cloud picture should be illuminated from the same side as is the landscape picture in which it will be used. Remember that brightly illuminated clouds should not be used together with a landscape made on a sunless or dark day. The cloud negative should be fairly

thin so that it can be viewed in proper position over the print to which it is to be added.

Begin by printing the landscape or foreground. Mask the sky portion of the negative so that that part of the paper will not be printed. For the mask use a sheet of sensitized paper on which the foreground scene has been printed, cut into two parts along the dividing line (horizon). For projection printing sketch the horizon on a cardboard on the easel and cut the cardboard into the two portions.

In contact printing fasten the negative to the glass of the printing frame and fasten the upper or sky portion of the mask to the face of the frame about a quarter inch above the glass. Cover the whole frame with tissue paper and print the landscape. Next place the cloud negative in the frame in exactly the same position as was occupied by the landscape negative or in the proper position for placing the clouds. Replace the sensitized paper on which the landscape has been printed in exactly the same position as before. Place the lower portion of the mask on the frame, cover with tissue paper, and print the cloud. In each case the mask must be raised above the glass of the frame about a quarter inch, so that the light will diffuse and not make a sharp dividing line on the print. Diffusion is assisted if the edges of the mask are serrated by means of a rough file. Illustration 31 shows the steps in the process. The two upper pictures are those to be printed together. At lower left is shown how an ordinary print is cut to make the two masks, and the finished product is shown at lower right.

To perform this process in enlarging, the halves of the cut cardboard mask may be held between the lens and the easel while printing each part of the picture. Make special test strips on each of the negatives, and the two negatives must be placed, one after the other in the enlarger, in exactly the same position.

Combination printing is used also for silhouetting figures against sky lines in landscapes or combining two or more pictures one over the other. Two negatives may be printed one on top of the other by fastening them together in the position wanted. Dark tones will

not show over other dark tones; the best combination is to print from the dark tone of one negative through the lighter tones of the other. For example, nearly anything can be double printed onto the blank sky portion of a landscape negative. The process is good for making bookplates or for combining photographs with printed text, as the photographs may be printed lightly over the text without obliterating the latter. For best registration, two negatives to be double printed should be bound together emulsion to emulsion, and used either in enlarger or in printing frame with the one that cannot be reversed (reading matter, for example) facing toward the sensitized paper.

Combination printing verges on another type of special darkroom work—photomontage (see below).

Decorations.—Photographs can be used for many decorative purposes, on screens, lamp shades, trays, and furniture. For using photographs on screens, photomurals (see Chapter XV) can be made to fit the screen panels. The panels can be divided into sections and prints made to fit the sections. For this purpose it is advisable that the pictures be of the same subject or group of subjects, and it is also advisable to have all pictures in a group of the same key; that is, light (high-key) pictures should not be interspersed with dark or low-key pictures. Otherwise the light pictures become "light traps," which catch the eye of the viewer and spoil the effect of the whole.

Lamp shades can be made from single negatives or groups of negatives, and one good use for color transparencies is in this type of decoration. The chief objection is that they are rather small. For making black-and-white transparencies for lamp shades use a film such as the Eastman Translite, with emulsion on both sides. It has about the same speed as a bromide projection paper and makes a beautiful transparency. It is available in the same sizes as cut paper, but costs about three times as much. As an alternative use single-weight enlarging paper, and oil it to make it more transparent. To mount either the transparencies or the paper prints on a lamp shade make a pattern of the covering of the shade. The transparencies

may be jointed together by tape and sewed to the metal frames of the shades.

Drawings.—If you have artistic ability you can project a film *positive* in the enlarger and sketch over the image projected onto drawing paper on the easel with charcoal, pencil, or pen and ink. An even better method is to project a *negative* onto drawing paper, and simply blacken the light areas. There is another simple method of making drawings from photographs. Take a matte print (contact or projection) and sketch over it in waterproof ink, either black, colored, or a combination of colors. When this drawing is dry, bleach out the photograph in a solution made by dissolving 60 grains of iodine crystals and 180 grains of potassium iodide in about 20 oz. of water. The print, immersed in this solution for 2 or 3 minutes, turns a deep red that obscures the image. Drain the print and place it in another tray containing a solution made by dissolving 4 oz. of hypo in about 20 oz. of water. In a few minutes the paper has turned white again, and all of the photographic image will have disappeared, leaving only the ink lines. The print should be fixed in the hypo for about 10 minutes, then washed and dried.

Fresson Process.—As this is a pictorial finishing process, it will be discussed in connection with exhibits and salons in Chapter XIX.

Greeting Cards.—You can make your own greeting cards by one of several methods. All the tricks of photography, such as combination printing, montages, etc., can be used. The simplest method is the single photograph. In this, you build subject and message into a single scene and photograph it.

The next simple method is to print from several negatives either by combination printing or by masking each negative into a portion of the card. A greeting card, using the latter method, may be made up of two or three component parts: photograph, greeting, and signature. You must have a separate negative for each of the three. The photograph may be any scene you desire, and the greeting may be any greeting that fits the occasion. You may hand-letter the greeting and do any art work that you want in black ink on white drawing paper, and photograph it with Kodalith film. The signature

should be made the same way and may be on the same sheet as the greeting. If using three separate negatives, they should be fastened together by black masking tape or fastened with tape to a black mask as shown in Fig. 56. The only care that must be exercised is that those used together be of equal density or nearly so, so that the card can be made in one printing operation. Failing this, you will have to print each portion separately, masking the rest of the card each time. You can purchase greeting card kits (especially

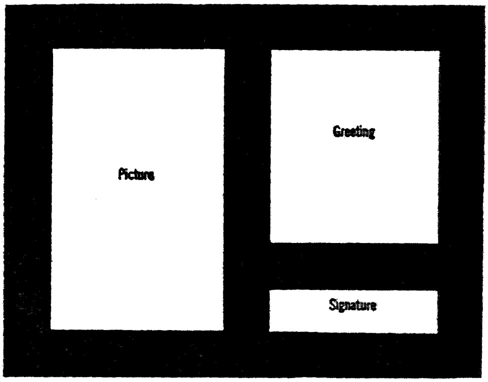


FIG. 56. GREETING CARD MASK

Christmas card sets), and these include several masks, both vertical and horizontal, and film negatives of numerous greetings.

Another, somewhat more difficult, method of preparing greeting cards is to cut out the outline of the figure or several figures and mount these outline figures over the greeting that has been lettered or printed on white cardboard, then rephotographing the whole. Still another method is by double printing. Be guided in this by the rules for combination printing so that you will not attempt to print a dark area over another dark area. Your own ingenuity is the only limit in making your personalized greeting cards.

Here are some general suggestions:

Decide first on the size and shape for your card. These should be determined by the size of envelopes that can be secured.

The elaborateness of the card must be governed either by the number you want to make or the amount you can spend. You may prepare your photograph and greeting and signature or other art work by collecting them all onto one white background sheet and then photographing the layout.

You can write on sensitized paper with lead pencil. This writing, after development, will appear in white letters, so do the writing on a dark portion of the picture.

You can deckle the edges of the cards by using a rasp, rough file, or a regular deckle-edge trimmer. Greeting cards should preferably be made on double-weight paper. There are many variations on the single card. You may use a single fold or what is known as the French fold, which is a sheet of paper folded twice, once each way. You can fold the prints while still wet, after they have been washed sufficiently. They will then hold the fold and the emulsion will not crack.

You may plan your folded card with a cutout, that is, a window in the top part through which the picture is seen.

Lantern Slides.—If you can make a good print from a negative you can make a good lantern slide. The only difference is that the slides are made on glass plates coated with the emulsion. These plates are developed, fixed, washed, and dried in the usual manner.

Lantern slide plates are usually made in three contrasts: the *soft* grade is for high-contrast negatives; the *medium* is for normal negatives; the *contrast* grade is for negatives of low contrast or for black-and-white work. The high-contrast and medium plates may be processed under a safelight such as the OA, but the soft plates have greater sensitivity and should be processed under a Wratten No. 1 safelight. The slide may be printed by either contact or projection. Usually the negative is not the exact slide size. If it is smaller it may be enlarged onto the slide; if only a portion of a large negative is wanted the slide can be placed to cover this portion of the negative in a printing frame. If the negative area is larger than 2¼ x 3¼ in. the slide must be made by reduction. If using an enlarger with sufficient bellows extension, or a homemade enlarger with a plate-back

camera, the double extension rack will probably be able to make the enlarger act as a reducer as well. The high-contrast slide plates require about three times the exposure of the medium, and the medium about seven times the exposure required for the soft.

In contact printing the emulsion side of the slide must be in contact with the emulsion side of the negative and the exposure made as though making a print. The slide can be placed in a projection machine in horizontal position only, with the shortest dimension up and down. In printing, therefore, the picture must be placed on the slide so that the bottom is parallel with the longer side, and it must be placed squarely or it will be tilted when projected onto the screen. Experimentation will give you the length of exposure necessary. A 25-watt frosted lamp at a distance of 6 feet from the printing frame will require about 5 seconds exposure on the medium plate. One slide can be used as a test strip, exposing with portions of it covered for different lengths of time.

A good developer for lantern slides is formula D-72, and you can judge the development by viewing the surface as you would a print. The rules for print exposure apply to lantern slides. If the image appears too quickly, the slide has been overexposed; if the image fails to gain enough strength when developed for the proper time, the slide has been underexposed. The slide should be rinsed in running water after development and fixed in an acid-hardening fixing bath (formula F-5), washed for a half hour in running water, wiped with a viscose sponge and placed in a rack to dry.

The only good way to test a slide is by projection. It may be spotted the same as a print, and slides may be toned in the same way as prints. It is best to varnish the slides to prevent the film from absorbing moisture. The picture on the slide may be framed or masked by scotch tape, regular lantern slide binder, or a mask of black paper cut to the proper size. After masking, the slide should be bound in contact with a cover glass by placing lantern slide binder around the four edges (see Fig. 57). If a small white circle or label is fastened to the lower left-hand corner, over the mask, this spot

guides the operator in inserting the slide properly in lantern or projector. Slides may be kept in boxes built to hold 50 or 100.

Color transparencies, as Kodachrome or Dufaycolor, 35 mm. or Bantam size, can be mounted by binding them with a paper mask between 2-in. glass squares with scotch tape, or they may be mounted in metal frames.

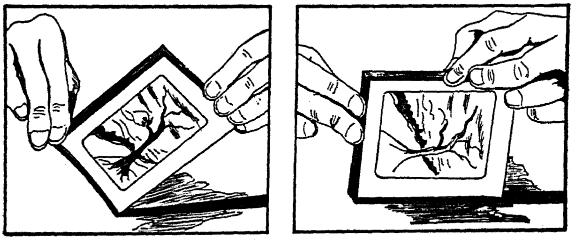


FIG. 57. BINDING LANTERN SLIDE

Paper Negative.—This is a pictorial finishing process and will be discussed in Chapter XIX.

Patterns.—Patterns may be made from even the most ordinary photographs. A photo pattern may be used for a pictorial picture, for a wall decoration, or for any other purpose. A pattern print is simply a picture made up from a number of prints or a portion of a negative.

First select from the negative file subjects with the proper composition. This is usually diagonal composition, or one in which the important lines run in a diagonal direction. Plan the pattern in advance. Use 4, 8, or 16 prints; half of them should be printed in reverse. Experiment by making several prints from a negative and cropping and arranging the group until the desired effect is secured. In addition to printing reverse prints, alternate prints are mounted upside down to secure the effect of a pattern.

Make a sketch of the layout to determine the size the separate prints should be. The prints should be made on single-weight paper and mounted on heavy cardboard with rubber cement, beginning at the center of the board and working out. The prints may be butted

or overlapped. If overlapped, it is best to start at the top or bottom of the board, overlapping succeeding rows. It is important that the prints be of equal density. If made in an enlarger, stop down the lens to use a fairly long exposure so that more exact timing can be given, and maintain a constant temperature of the developer. Illustration 32 shows a pattern made of 16 prints.

You can examine prints that you think will make good photo patterns by using two glass mirrors hinged together with tape. Place these on a table, open them at right angles, and place the corner of the print at the point where the mirrors are hinged together. By reflections this print then becomes four prints, and you can try different corners of the print to see if a satisfactory pattern can be made. Part of the print is often better than the whole. Simply slide the print under the corner of the two mirrors to crop it to the position desired for the test. You can also make a pattern of four prints and give this four-print pattern the mirror test.

Photograms.—These are photographs made by light rays, without the use of a camera, simply by exposing sensitized paper to rays of white light after having placed objects between the paper and the light source. The shadows of these objects will be recorded on the paper, light if the objects are opaque, somewhat darker if the objects are translucent. The first photogram was probably made by Fox Talbot by placing lace on a sheet of his calotype paper and exposing it to light.

Perhaps the best method of making photograms is to arrange the objects on a sheet of thin glass. These objects may be any sort of glassware, kitchen utensils, cutouts, or small figures—in fact, anything that you can make into a picture. Each object is recorded on the sensitized paper according to the amount of light it permits to reach the paper, and according to the direction from which the light comes. It is even possible thus to record only the shadows of objects rather than the objects themselves, and you can "work up" or design a picture just about the same as for tabletop photography.

Dark, opaque objects will give silhouettes, and you may be able to print into your scene some opaque objects together with some

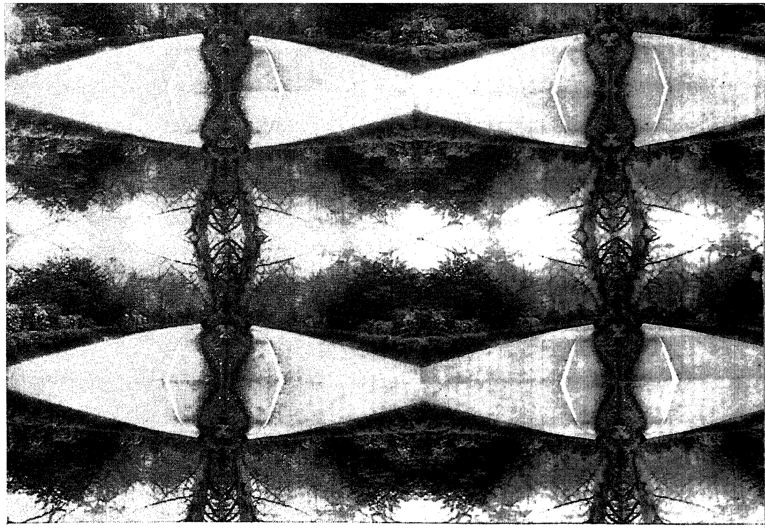
that are translucent or partly transparent. The simplest type of photogram is to record the outline of an opaque subject placed directly on top of the sensitized paper; but to make a more elaborate layout or setting it is best to work it up on top of the thin plate of glass. When the setup is ready, slip the sensitized paper under the glass and make the exposure by use of a weak light bulb several feet from the paper or by an ordinary flashlight. The paper should be chloride paper (bromide papers are too fast) and the exposure will usually be several seconds. It is difficult to visualize in advance the variations caused by shooting the light from different angles; this can be done partly, however, by examining shadows or reflections on a sheet of white paper. It is best to plan the layout to have a light source directly overhead.

Opaque objects will record in white outline on the paper, and translucent objects will record in various tones. In either case the outlines will be shown, and the rest of the paper will become black in the development. If the photogram has been made on single-weight paper, this paper can then be used as a negative for printing positives. Illustration 33 shows a photogram (above), together with positive printed from it (below).

Everything that you find around the house can be used in making photograms, and the number of variations in layout of subjects, in angle of lighting, or in intensity of light and contrast is infinite.

Photomontage.—This type of photographic work is really double printing or multiple printing, one negative over another, but more often of negatives or portions of negatives side by side. A true montage is made up of a number of different pictures or portions of pictures, generally all on one subject or idea. Each portion of the montage may portray or depict some phase or portions of a centrally illustrated subject: the central, or largest, portion should be a picture of the whole. Montages are often used in advertising work, showing centrally a particular product, with insets or smaller pictures around the main one, showing various close-up views of the product or parts of it.

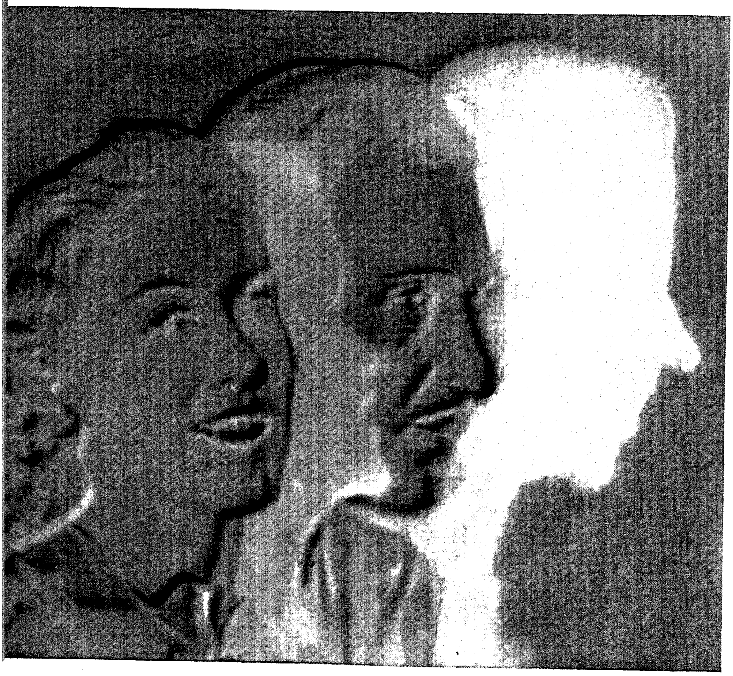
The simplest montage is made by cutting actual prints into smaller



32. (*Above*). Pattern.
33. (*Right*). Negative and Positive Photograms.

34. (*Left*). PHOTOMONTAGE. *Photograph by Claude Pilger. Voigtlander Camera, Superpan cut film, 1/10 sec., f:16; 3 exposures on 2 negatives.*

35. (*Below*). RELIEF PRINT. *Made from Paper Positive and Negative; See Illustration 28.*



sections, fitting them together into a sort of jigsaw puzzle, and then pasting them on a cardboard background. The entire layout is then copied photographically. More elaborate montage work consists in projecting negatives or portions of negatives in the enlarger, masking off portions of the sensitized paper on the easel by means of masks cut the proper size and shape held about an inch above the easel or even placed in contact with the paper. This method, of course, does not include the printing of one negative over another.

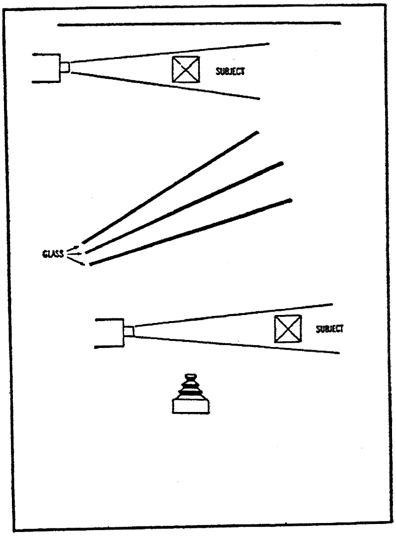


FIG. 58. ONE-SHOT MONTAGE DIAGRAM

To do this, follow the general rules for double or multiple printing. Portions of negatives not wanted can be cut off or reduced off by use of local reducers. In any case, the separate portions forming the montage must be timed in exposure to make equal tones. Illustration 34 shows a photomontage.

You can also make a montage by actual photography. This "one-shot" montage can be secured by photographing reflections in ordinary pieces of glass. Use a really dark room so that the light can be controlled. Use one, two, or three sheets of plain glass about 2 feet

square. These pieces of glass should be placed on edge on a table covered with a black cloth. This can be done by placing one end of each piece of glass in a notch cut in a block of heavy wood (see Fig. 58). Place a subject back of these pieces of glass and the camera in front of them. Light the subject from one side, or from both sides, taking care that no light strikes the glass. Next place a subject (one or more persons) on the front side of the table at the right of the camera so that the *reflections* of this subject may be seen in the pieces of glass. This photograph will then include not only the subject back of the pieces of glass but three separate reflections, slightly overlapping, of the subject in front.

The effect can be varied by using foreground subjects of various sizes and materials, and by the position of either the subjects or the pieces of glass. There are many possible variations. Mirrors may be used to good advantage to double images. Spotlights are better than flood lamps for this type of work.

Photomurals.—See Chapter XV.

Reliefs.—These are, in fact, "pictures with depth," in which the picture seems to be raised from the surface of the print in what is known as a bas-relief. They are also called cameos or intaglios. The usual procedure is to select a negative with strong lines (profile portraits are good), then make a positive on film. This positive should have at least as high a degree of contrast as the original negative. When developed, washed, and dried, the positive should be placed over the negative. When completely in register the picture on each disappears, because the dark areas of one completely cover the light areas of the other. Move one or the other slightly in a diagonal direction. This should be done over a lighted glass desk, of course. The picture will reappear to a certain extent. Where the lines on positive and negative do not meet there will be light streaks, and where they overlap there will be dark lines. When you have the positive and negative placed to secure the most striking effect, or the effect desired, bind the two together with scotch tape and make a print through both. The result depends entirely on how the densities of positive and negative differ, how much out of regis-

ter the two are, and in what direction. The best relief effects are obtained if both positive and negative have good contrast and are of equal density; any amount of variation can be obtained by making positives of different densities.

The same procedure can be followed with paper positives and negatives and this method, as in the case of the preparation of exhibition prints (see page 231), permits all the retouching and manipulation that you need or desire. Illustration 35 shows a relief made from a paper positive and negative. (Refer to Illus. 28, which is a texture print made from this paper negative.) Double reliefs can be made by printing, not only through positive and negative but by including a pattern or design background negative (or positive) as well.

Chapter XVIII

COLOR PRINTS

Color film has reached a degree of development permitting quite satisfactory pictures (transparencies) to be made in full color. The taking of pictures on color film and the composition and working of both Kodachrome and Dufaycolor film have been discussed in Chapter XI. The development of Dufaycolor is outlined in Chapter XV.

Color *prints*, however, are another matter entirely. Color-printing processes are new; existing processes are being revised daily; new processes are appearing at an alarming rate. The photographic world is groping for methods whereby prints in full color can be produced *simply* and *inexpensively*, in the firm conviction that, within a few more years, everyone will be using color film and demanding color prints of the finishers. This chapter is included in this book solely because color is definitely the coming thing, and a knowledge of photography today must include some acquaintance with color prints and color-printing methods. I am forced to mention at the outset the likelihood that, by the time you read this chapter, nearly everything said in it will be out of date. If the development of color-printing processes continues along the same lines as in the past, this chapter will furnish you a foundation on which to build; if, however, it takes an entirely different tack, the information in this chapter can serve only as historical material.

SEPARATION NEGATIVES

Color-printing processes, in general, require separation of the colors of the original subject by making what are called "separation negatives." These are made in two ways: (1) separation in taking the picture and (2) separation from color transparencies. In the first, separation in the process of taking the picture (actual photography) there are two methods: (1) one shot (single exposure) and (2) three separate shots or exposures.

One-shot Color Cameras.—There are three methods of one-shot color photography. The first will work in any plate-back camera. It involves the use of what is known as a tripack, which is simply an assembly of three films loaded together. The front film is sensitive to blue light; the second film is sensitive to green; the third film is panchromatic. The light reaching the second film is filtered through a yellow dye on the first film (on the emulsion), first and second units of the tripack placed emulsion to emulsion; the light reaching the third film is filtered through a red coating on the back of the second film. The chief disadvantage of the tripack is that the image on the third film becomes slightly diffused.

To correct this diffusion a different setup is sometimes used. Special cameras are built with a single mirror made in such a way that it will permit part of the light to pass straight through, and will reflect part of it. This semireflecting mirror reflects part of the light to what is called a bipack (such as the Defender Dupac). The Dupac consists of two film layers, emulsion to emulsion. The front film is sensitive to green and blue, and the second film is sensitive to red. The front film has a red filter layer coated over the emulsion so that only red light is transmitted to the back film. (The Eastman bipack is made the same way except that the second film is panchromatic.)

With a yellow filter in front of the Dupac the front film records the green and the back film records the red. The light passing through the mirror records on a separate film, which may be either special film sensitive to blue light only or a panchromatic film with a blue filter placed in front of it. The single-mirror camera thus

makes green and red filter negatives on the Dupac and the blue filter negative on the separate film.

There are some variations in this type of camera. One uses a magenta filter (which transmits red and blue) in front of the Dupac so that the front film records the blue and the back film the red. The third, or single, film is then panchromatic, with a green filter before it. Still another variation is to use the first two units of the tripack together in a single-mirror camera in which the mirror itself is red. The first unit of the tripack is sensitive to blue, and its emul-

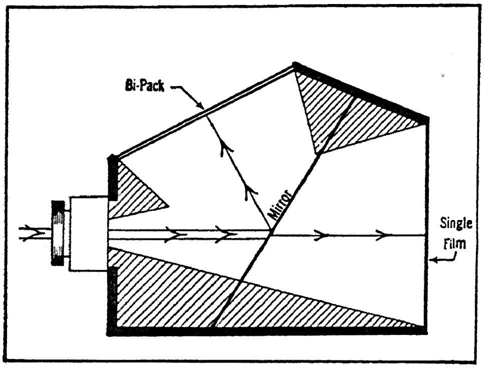


FIG. 59. SINGLE MIRROR COLOR CAMERA

sion is coated with a yellow dye transmitting light to the second unit, which is sensitive to green. The red mirror then acts as a filter so that the red light records on the panchromatic single film. Still another variation on the last-named method is to use the two front members of the tripack as explained, with the third member on the direct beam behind the red filter. In the first case it is a blue record that is taken on the separate film on the direct beam; in the second it is the green record; in the third method it is the red record. See Fig. 59 for diagram of the single-mirror camera.

The Double-mirror Camera.—This type of one-shot camera offers, perhaps, the best method of making color separation negatives in actual photography of the subject. The camera includes two semi-

reflecting mirrors (see diagram Fig. 60). The first mirror passes part of the light (the direct beam) and reflects part; the second mirror also passes part of the direct beam and reflects part. The light reflected from the first mirror, the light reflected from the second mirror, and the balance of the direct beam then record in three separate focal planes. At each of these focal planes is placed a piece of panchromatic film, and each has a filter placed before the film. These filters are, respectively, red, green, and blue.

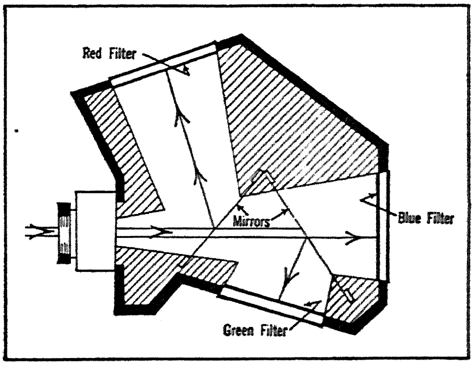


FIG. 60. DOUBLE MIRROR COLOR CAMERA

Three-shot Separation.—We have discussed the methods of making the separation negatives in one shot: (1) tripack in plate-back camera; (2) bipack in single-mirror camera; (3) double-mirror camera. The separation can be made also by making three separate exposures, one after the other, through the three filters, red, green, and blue. This method, of course, cannot well be used on living subjects, as the camera must be kept in exactly the same position and there must not be the slightest movement in changing the film holders or filters. The filters used over the lens are the Wratten A, B, and C5, known as the 25, 58, and 47. Panchromatic film is used for all three exposures, though some recommend panchromatic for the red and green filters and blue record film for the blue. In making the separate exposures the filter factors must be taken into consideration.

There is a special kind of film holder in which the different films are loaded side by side, each behind its filter. The holder can be slid across the focal plane of the camera so that one film after the other is exposed. With practice, and by use of the green sensitive orthochromatic and blue record films, this method can be used on a living subject, provided only the subject can remain perfectly still.

In taking separation negatives by actual photography there should be placed somewhere within the field of view where it will record on the film, but may be trimmed off in the finished picture, what is called a "negative identification chart," a gray scale (also called a neutral scale), and registration marks. The negative identification chart includes patches of three colors, blue, green, and red; these are labeled, respectively, Y, R, and B, because the separation negatives made with filters of the colors named become the "printers" for the colors as marked (see below). The gray scale is simply a strip of patches of gray ranging from black at one end to white at the other. This is used as a guide for the developing. These charts can be obtained from photographic supply houses.

Separation from Color Transparencies.—The separation negatives can be made in the darkroom from color transparencies. These can be enlarged to 8 x 10 or even more, with the filters over the lens of the enlarger and panchromatic film on the easel or in the printing frame. The easel or printing frame must be placed in exactly the same position under the enlarger for each exposure. The filters used are red, green, and blue, respectively: Wratten F, No. 9; N, No. 61; and C4, No. 49. These may be bought in 2-in. gelatin squares. A photograph of the gray scale the length or width of the transparency should be mounted beside it between the cover glasses.

It is advisable to build a cardboard cabinet over the easel or printing frame with an opening at the top, just under the enlarger lens, so that there is less danger of fogging the film by stray light. The proper exposure can be discovered by experimentation, though basic figures are supplied for the various color printing processes (see below). The enlarger lens should be stopped down to give exposures of 5 to 10 seconds if possible, as it is easier to time longer

exposure accurately. The use of a metronome is one of the best means of timing the exposure. The developing times and solutions also vary according to the method used.

Still another method of making separation negatives is to illuminate the transparency, mounted in a large shield, by means of light (of the proper color temperature) reflected onto it from behind. The illuminated transparency may then be photographed with a regular camera, making three separate exposures, with the three filters. This method permits more accurate timing of the exposures.

Summary.—Separation negatives may thus be made in the following ways:

1. Actual photography
   (*a*) Use of the tripack
   (*b*) Single-mirror camera (with bipack and one panchromatic film)
   (*c*) Double-mirror camera (with three panchromatic films; two or three members of tripack)
   (*d*) Three separate exposures
   (*e*) Three separate exposures with sliding back
2. From color transparencies
   (*a*) Enlarger
   (*b*) Camera

As stated at the beginning of this chapter, there is no guarantee that future color-printing processes will even slightly resemble those in use today. It is entirely possible that color separation into three separate negatives will not be necessary. However, as this is necessary in the color-printing processes in use today, I have included the above brief summary. You should not attempt any of the color processes without securing complete instructions from the manufacturer, and you may secure additional information on separation negative work from the following references:

Dunn, Carlton, *Natural Color Processes.* Boston: American Photographic Publishing Company, 1940.

Potter, Rowland S., *Methods of Making Three Color Negatives.* Defender Photo Supply Co.

Henney, Keith, *Color Photography for the Amateur.*

Fraprie, F. R., *How to Make Prints in Color.*

Newens, Frank R., *Technique of Color Photography.*

Outerbridge, Paul, *Photographing in Color.* New York: Random House, 1940.

Keith Henney has a short article "How to Make Separation Negatives from Color Transparencies" in *Popular Photography* for January, 1939.

COLOR-PRINTING PROCESSES

There are available several processes for making prints in full color on paper. These processes are in a state of constant change; they are being perfected and simplified; and they will either be greatly revised or entirely replaced by still other processes within a comparatively short time. Though several processes are outlined below, I cannot give sufficient space to adequate explanations and instructions for these processes in this book, for two reasons: (1) the processes may not still be in use, and will undoubtedly have been greatly revised, by the time you read these lines; (2) the processes are quite fully described and thorough instructions included in booklets, either available free of charge from the manufacturers or included in the special packages or kits of materials. The processes are also discussed at some length in the references on separation negatives given above, and many magazine articles are keeping abreast of the times by describing recent developments in this field.

Eastman Wash-Off Relief.—The separation negatives for this process, if exposed by actual photography, follow the exposure rules for general photography. Use electric exposure meter and compute for the filter factors. If made from color transparencies, the correct exposure may be discovered for the red filter by trial and error, developing for 5 minutes in DK-50, diluted 1 to 1, at 70° F. Exposure for the red filter taken as 1, the exposure for the green filter negative should be 1.8, and the exposure for the blue filter negative 4. The green filter negative is developed for 5 minutes and the blue filter negative 7 minutes. These figures vary somewhat for separation negatives made in actual photography, and so do the developing times.

The three separation negatives are printed, by contact or projection, on Eastman Wash-Off Relief film, the exposure being made through the support of the relief film, so that the exposed portion is nearest the support. The exposed reliefs are developed in DK-50, washed, bleached, and then "developed" in hot water until the emulsion is washed off the support, leaving the faint, bleached silver image on the support. The reliefs are then dyed: the relief from the red filter negative is dyed in the blue dye; the green filter negative relief is dyed in the magenta dye; and the relief from the blue filter negative is dyed in yellow dye.

The dyed reliefs are then transferred, by a process called "imbibition," onto white photographic paper that has been prepared in advance for this treatment. The red relief is transferred first, then the blue relief directly on the red, in register, and finally the yellow. The result is a full-color print on paper.

To use this process you will need the special booklet issued free by the Eastman Company: *Color Printing with Eastman Wash-Off Relief Film.*

Chromatone Process.—From the separation negatives taken through blue, green, and red filters black-and-white positives are made on a special stripping film, called Chromatone Printing paper. The final color print depends on the care used in making the black-and-white positives. These prints are developed together and fixed. While in the fixing bath the films can be stripped from the backing paper. The prints made from the green and red filter separation negatives are bleached in a solution called red toner A. After this the positive from the green filter negative (which becomes the red printer) is placed in red toner B, and the positive from the red filter negative (which becomes the blue printer) is placed in blue toner B. The stripped print from the blue filter negative (which becomes the yellow printer) is bleached and toned in yellow toner A and yellow toner B.

These three images, toned their respective colors, are registered on a gelatin-coated paper called Chromatone Backing paper; the

yellow image placed first, then the magenta, and finally the blue. The result is a print in full color.

This process differs from the Wash-Off Relief process in the fact that the latter makes reliefs from the separation negatives and the Chromatone process makes prints on transparent surfaces which may be stripped off the backings. Also, in the Chromatone process, these stripped-off prints, when dyed and assembled, become the final print; whereas in the wash-off process the print is made by transferring the dye only from the reliefs. Thus, the reliefs can be redyed and reprinted many times, though a Chromatone print requires the reprinting of the positives from the separation negatives each time.

To perform this process you need the booklet *The Defender Chromatone Process*, which costs 25 cents or is included with the $10 "Chromatone Photo Print Package."

The Carbro Process.—In this process ordinary black-and-white bromide prints are made from the three separation negatives. These are washed, fixed, and dried; then they are soaked in cold water and placed in contact with carbro pigment papers on which are formed red, blue, and yellow pigment images formed by chemical action from the silver images in the bromide prints. These pigment sheets are developed on a celluloid backing in hot water, which washes away excess color. A "temporary support" is squeegeed on the blue pigment image, which then comes off its celluloid backing. On this the others are registered in turn, the yellow last, and stripped away from their celluloid backing. The three images on the temporary support in reverse order (yellow uppermost) are squeegeed to a gelatin-coated paper. This assembly is immersed in hot water and the temporary support is then stripped away, leaving the three registered images on the paper backing in proper order. The result, after drying, is a print in full color.

This process is called the Carbro process because of its similarity of procedure to the "carbon," or Fresson, process of making black-and-white salon prints (see next chapter). For this process you need the special instruction book that comes with the kit or can be purchased separately at 75 cents, though the process is described

much more in detail in *Natural Color Processes*, by Carlton E. Dunn (see reference above).

Other Processes.—In addition to the processes described here in brief there are several others, such as the X-Or color prints, and a contact printing paper issued by the Vitachrome Corporation, from which contact prints in color may be made in one separation from Kodachrome or Dufaycolor transparencies. The latter is a printing-out paper. The Duxochrome process is similar to the Wash-Off Relief, except that the complementary colors are embedded in the gelatin, and consequently the reliefs do not have to be dyed by the operator. Colorstil is a process almost identical to Duxochrome. The Belcolor is a film that permits "stripping" in register to paper, like the Carbro process. Information on these processes is lacking at the present writing.

The latest innovation in color printing involves the use of what are called "dye-coupler developers." These eliminate the intermediate step of dyeing; they bring out the colors by actual development, producing a colored image directly from the latent image in the sensitive material. The oxidation products of development are dye-forming intermediaries and combine with certain organic compounds to form finished dyes in several colors. Usually photographers are concerned only with the silver image; in dye-coupler work only the oxidation products of development are of importance, the silver image being dissolved out.

This process may be used to make color pictures by (1) producing in the emulsion, at different depths, latent images recording the three primary color sensations and (2) producing, from three separation negatives, colored images in thin, transparent films that may be stripped in register onto paper. It is likely that the dye-coupler process may be widely used in the making of color prints, until it, in turn, is replaced by some simpler process. The process has also been used to develop Kodachrome film in the home darkroom.

Chapter XIX

EXHIBITIONS AND SALONS

It is the ambition of most photographers to produce pictures for competitions, exhibitions, and salons. Most beginners do not know what exhibition pictures are or how to enter them.

An exhibition print is one that is well made and has definite pictorial and subject appeal. It need not be made with an expensive camera; the "seeing eye" and care in the darkroom processes are more important. Though correct exposure, developing, and printing are necessary, the picture must first of all be of a subject that appeals to the imagination and has good composition. Texture printing improves many types of pictures, and the special finishing processes, such as bromoil, paper negative, or Fresson (see below), as well as toning, add to photographic excellence. For exhibition purposes prints must be fairly strong in tone, so that they will stand out when viewed from a distance under artificial light. The prints must be mounted, of course. Most exhibitions and nearly all salons require white mounts of 16 x 20 in., used in vertical position. The mounting may be done in any of the ways mentioned in Chapter XV.

EXHIBITIONS

Exhibitions are usually held by camera clubs, photographic publishing companies, photographic supply houses, newspapers, fairs, and so on. Many of these are also competitions, offering awards or prizes. Some may be snapshot competitions, requiring that the pic-

tures have been taken after specific dates and also requiring that the pictures be unretouched in any way. Most exhibitions permit the use of professional finishing. We give here a sample of the rules of a camera club annual show or exhibition.

Rules for Exhibit.—Photographic prints from negatives made by members are eligible, subject to the following conditions:

1. No hand-colored prints will be accepted.
2. Prints must be seven inches or larger in shortest dimension.
3. Light-toned mounts, 16 x 20 inches, should be used.
4. Names of exhibitors should not appear on the front of the print.
5. A title may appear on the front of the mount.
6. The elimination of as many pictures as necessary to ensure a high standard of quality in the exhibition is the duty of the jury chosen. However, each person submitting prints will be assured of having at least one of the group hung.
7. Not more than twelve prints may be submitted by one member.
8. The following information must appear on the back of each print:
   (*a*) Exhibitor's name, number and title of print to correspond with entry form; also process and sale price.
   (*b*) If the print or enlargement was not made by exhibitor himself, the words "Not printed by exhibitor."
   (*c*) The words "first choice for exhibition" on the one print which you consider your best for the exhibition.
9. Prints entered for exhibition, along with an entry form properly filled out, must be left in [place] not later than [date].
10. Prints for exhibit will not be accepted from members not in good standing, that is, whose annual dues are not paid to date.

The above are rules as used by most local camera club exhibitions. Most clubs would use rule 1; size as given in rule 2 may vary; some clubs permit various sizes of mounts; rule 7 may vary. Rule 10 is used by most clubs, as it is an excellent way of securing payment of dues. Many clubs do not grant the privilege of hanging at least one print from each member, though this rule brings more prints to the exhibition.

In connection with rule 8, many exhibitors use a rubber stamp bearing name and address. Also, the matter of how information on a particular enlargement should be kept has always been a problem.

There is a great deal of information on each print, especially in the case of paper negative or other pictorial processes, that the photographer wants to keep, somehow. Figure 61 shows a form I

```
Title.................................
Negative no............Print no.........

Subject...............................
Location..............................
Lighting..............................
Camera................................
Lens.............Stop.....Speed.......
Film..................................
Developer..............Time...........

Contact print. Paper..................
Developer..............Time...........
Projection positive. Paper............
Diameter enlargement..................
Developer..............Time...........
Paper negative. Paper.................
Developer..............Time...........
Final print. Paper....................
Developer..............Time...........
Remarks...............................
......................................
```

FIG. 61. INFORMATION STICKER

have made for this purpose. This form is mimeographed on gummed paper.

Entry Blank.—The local camera club exhibition entry form is simple, and usually mimeographed, as shown in Fig. 62. Some camera manufacturers offer prizes. Most of them do not limit the photographer as to subject matter, but make the stipulation that the prize-winning pictures become their property, and that the photographers must lend them the negatives. Entry blanks can be obtained from the manufacturers or from the officers in charge of the exhibitions or competitions. Exhibitions, competitions, and salons are being held all through the year. Lists or calendars are printed regularly in most photographic magazines.

Classes.—Most camera club exhibits do not group pictures by classes. Such grouping is, however, usually made by fairs, newspaper competitions, and snapshot competitions. The classes usually include Children, Sports, Pictorial, Still Life, Portraits, or variations

on these subjects. The annual newspaper snapshot contest usually has only four classes. This contest offers weekly prizes in local newspapers, and has a national competition at the close of the season,

ENTRY FORM
Lincoln Camera Club
Fifth Annual Exhibition of Prints by Club Members
November 20 to December 7, 1938

No.	TITLE (print plainly)	PROCESS	PRICE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

Place a check mark beside the number of your "first choice for exhibition" print.

Name________________ Address________________

FIG. 62. ENTRY BLANK FOR CAMERA CLUB EXHIBITION

offering four first awards of $500 in each class, and a grand sweepstakes prize of $1,000.

SALONS

Salons differ from ordinary exhibitions in one or two particulars. They are held usually by camera clubs, and are frequently international in scope. They make no suggestions as to subject matter of the pictures, nor do they class or group them in any way, but they sometimes demand that the finishing work has been done by the entrant, occasionally referred to as "the artist." Salon rules follow a pattern, as follows:

The [ordinal numeral] Salon of the [name] Camera Club will be held from [date] to [date] in the galleries of the [name] Camera Club, [address].

The aim of this exhibition is to exhibit works of photography which show a distinct evidence of personal artistic feeling and ability.

Four prints may be submitted by any contributor.

Each picture must bear on the back the name and address of the maker and number and title of picture to conform with the entry form. The sale price, if any, must appear on the entry form only.

A commission of 15% will be charged on any print sold.

The entry form with a fee of $1.00 must be properly filled out and mailed separate from the prints to the [name] Camera Club, [address], and must be received prior to [date].

Foreign prints must be sent postpaid to the [name and address], to arrive before [date], using the printed label with the notation: "Photographs for Exhibition Only. No Commercial Value. To be Returned to Sender."

Foreign prints should not be larger than 30 x 40 cm. in size and should be sent unmounted, mounting being done by the committee.

American prints must be mounted on 16 x 20 light colored mounts to hang vertically.

All possible care of prints will be taken, but no responsibility is accepted by the [name] for loss or damage in transit or during the exhibition.

Unless otherwise specified, permission to reproduce is assumed. No reproduction fee will be paid.

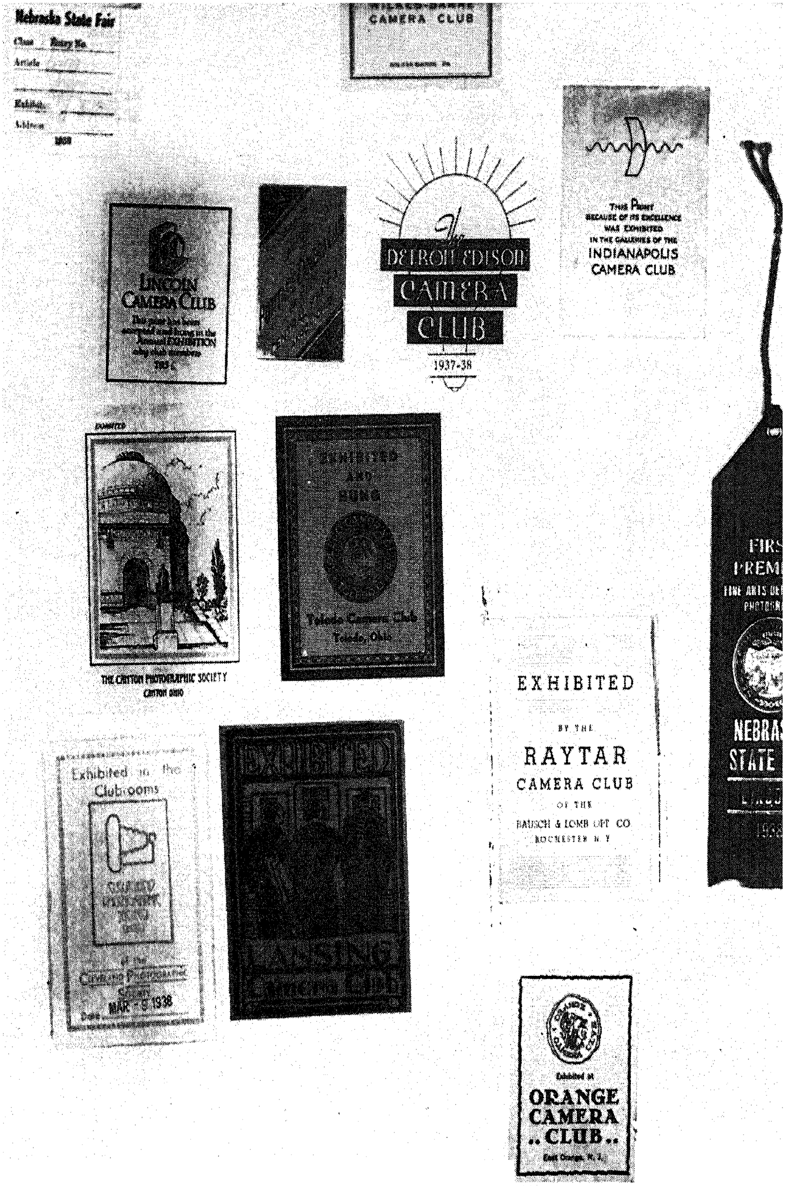
The prints will be returned promptly after the close of the salon.

A catalog will be sent to each exhibitor.

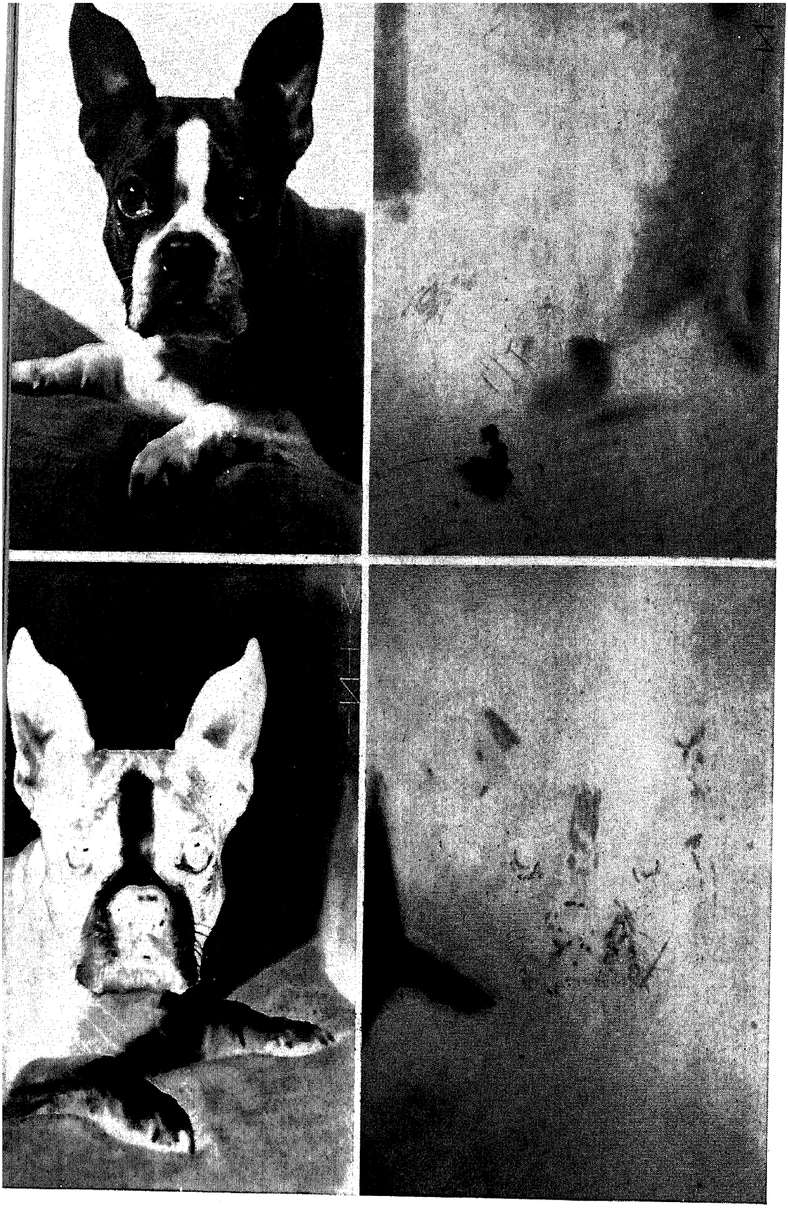
In case of an unforeseen contingency the committee's decision will be final.

As already stated, most photographic magazines include a calendar of forthcoming salons. This calendar includes the closing date, that is, last date on which prints will be received; entry fee (usually $1, for four prints); name and address of secretary; date of actual exhibition. Most salons will consider only four prints. Some salons notify entrants of acceptance of some or all four prints in advance of the exhibition; some notify only by sending printed catalogue of the exhibition either before, during, or after the exhibition. Most salons return no prints, neither accepted nor rejected, until after the closing of the exhibition. Some issue medals, or notices of acceptance of prints, but most of them simply place the salon stamp on the back of accepted prints (see Illus. 36).

Methods of Judging.—These methods differ, though the selection is usually made by a carefully chosen jury or committee. In some cases the members of the judging group are given cards with num-



36. Back of a Much-Exhibited Print.



37. PAPER NEGATIVE PROCESS. *See Frontispiece.*

bers from 1 to 10. As each print is held up for the judges' consideration, each judge holds up one of the numbers, depending on how good he thinks the picture is. The numbers are totaled for each print, and the prints are placed in piles according to their ratings. If there are three judges, 30 would be a perfect score, of course. The number of prints that can be included in the exhibition is determined beforehand, and then all the highest rating prints are taken until the number is filled. This might mean that only prints with a rating of 20 or better could be included, though it might mean that prints with ratings as low as 16 or 18 might be accepted.

Another method of judging is by letters, A, B, and C; in this method the number of prints that can be used again determines the lowest rating. And it may happen that prints receiving B rating from all judges might be accepted. Still another method is by simple vote, two out of three judges being able to pass a print.

Entry Blank.—If you have prints ready to submit to a salon, first determine from the calendar in the magazines what salon or salons

LEAVE BLANK	NUMBER	TITLE	PROCESS	PRICE

Permission is granted to reproduce any of the above prints.

FIG. 63. ENTRY BLANK FOR SALONS

are to be held in the near future. Write to the secretary for an entry blank. Be sure the closing date is far enough away so that you can receive the blank and still have time to get in your prints. The entry blank will usually be a four-page folder, including the salon rules (as give above), the official entry blank, mailing labels, and, often, print labels as well. The entry form usually starts with: "I submit the following prints for the consideration of the Jury of Selection of the [date and name] Salon. I enclose an entry fee of $1.00 payable to the [name] Club." This is almost invariably fol-

lowed by the boxed form shown in Fig. 63—a form that has become universal. Following this form are spaces for name and address of entrant.

You will note that the form provides space for four prints, and space to indicate the process by which each was made (bromide, chloride, chlorobromide, paper negative, bromoil, Fresson, etc., see discussion below), and space to indicate selling price. If you wish to sell your prints, you may indicate the price on the form. This price may be from $5 to $15 or $25, though more often it is $5.

The entry form, together with fee, should be sent separate from the prints, and the prints themselves should be well wrapped to prevent bending. For this purpose camera stores supply corrugated cardboard wrappers. Use mailing label as supplied. It is wise to keep a record of the prints, indicating to which salons they have been submitted, so that you will not repeat next year. Prints sent abroad should be sent unmounted; the committees in charge will mount accepted prints.

SELLING PHOTOGRAPHS

If you can take good pictures and can learn to know what publishers and advertisers want, you will be able to sell your pictures. In order to do so you must know the "market," and several market

City.. Date..

For value received, I hereby grant permission to

.... Photographer

to reproduce from pictures taken of me, described on the reverse side of this agreement, and, further consent that reproductions of same may be used or sold for the purpose of high-grade illustration, advertising or publication in any manner. I further certify and covenant that I am over twenty-one years of age.

....
Name of Model

Witness
....

Form 10A "Photo-Markets" Baltimore, Md.

FIG. 64. RELEASE FORM FOR ADULTS

guides are available, listing publishers and telling what each wants in picture size and text, and what payment is made.

Pictures sold for advertising purposes must be accompanied by "release" forms signed by the models or recognizable persons in the pictures. Forms for this purpose are made in two varieties, one for adults and one for minors; in the latter case the parent or guardian signs the release. Both forms are available from the Photo-Markets Company at nominal prices. The adult release form is shown in Fig. 64.

FINISHING PROCESSES

Prints made by contact printing are usually on chloride papers; enlargements are usually on the faster bromide papers. Other finishing processes include the following:

Paper Negative Process.—This process provides the maximum of control for the amateur, since it permits art work and retouching on paper positive, paper negative, or both. The simplest instructions are as follows:

1. Make, by projection, a positive print, composed and cropped as you want the final picture to be, and the same size as the final picture. This positive should be made somewhat darker than normal. It should be tested by transmitted light rather than reflected light, as it is to be used for contact printing, and should therefore be examined as a film negative would be. For best work the original negative should be rather soft. The paper used for this positive should be single-weight, and may be such surface as Kodabrom N, Defender's Velour Black N22, or Dassonville's Charcoal Black, Opaline parchment finish F. I usually use the Velour Black.

2. The positive, when processed and dried, is mounted on a glass table or retouching desk, and the art work done on it with pencil, crayon, powdered graphite, or Rising Sun Stove Polish. The last item is recommended by Dr. Max Thorek and I have used it for some time. The art work on the positive may be done on either the face or the back. The retouching out of spots and accentuating of

lines and shadows may perhaps be done better on the face, though the inclusion of a suitable, darkened background may best be done on the back of the positive. In brief, any portions of the print that you would like to have darker may be made darker on this positive. Apply the darkening medium with a French stump for small areas and wads of cotton for larger areas. Do not try to achieve full darkening effect in one application; rather, build up the shadow by repeated applications. Darken the corners of the print, to give depth.

3. From the retouched positive print a negative by contact. Place the positive and the sensitized paper face to face (emulsion to emulsion) in a printing frame, held at about 3 feet from a 20-watt light bulb or, better, place the printing frame under the enlarger lens at about 3 feet. As in the case of the original positive, you can run a test strip to determine the proper exposure. The paper negative should be exposed for good contrast, though retaining, if possible, the tones of the original.

4. Do the necessary art work on the paper negative after it has been fixed, washed, and dried. Here you can lighten tones you want lighter or remove unwanted shadows. As you are working on a negative, the light areas of the original picture here appear as dark areas. Consequently, you can make *additional* light areas or lighten areas simply by darkening them on the negative.

5. Print, emulsion to emulsion, the final print. Paper positive and negative must both be on single-weight paper, but the final print may be made on paper of any weight or contrast that brings the effect desired.

Illustration 37 shows the steps in the paper negative process. At top is the positive made by projection from the negative shown in Illus. 24, together with art work done on the back. At bottom is the paper negative and additional art work done on its back. For the final print, see Frontispiece.

There are some alternate methods. For example, some workers believe the negative should be made from the original positive by placing both emulsion side up in the printing frame, so that the

light may reach the emulsion after passing through the base of the paper, thus smoothing out the texture. In the final stage, printing the final print from the paper negative, the two may be placed back to back, to secure grain or texture.

The Dassonville Company supplies instructions for three methods for use of Charcoal Black Paper: (1) no-grain method; (2) single-grain method; (3) full pictorial grain method.

Another variation is to make a positive on film by contact, then make the paper negative by enlargement. This process is preferred by some workers though it permits less manipulation than the enlarged positive print methods. In any case, use developers recommended by the paper manufacturers.

For more complete treatment and discussion of the paper negative process see Dr. Max Thorek's *Creative Camera Art* (1937) or Nowell Ward's *Picture Making with Paper Negatives* (1938).

Bromoil.—In this process the final print is made by transferring the image from an inked print to a plain piece of paper. The image is made by pigment in an oily ink on the gelatin surface of bromide paper. The name was coined by using the first syllable of bromide and the word oil, referring to the oil medium of the ink. The bromoil method given in digest here is that of Charles H. Partington, who is well known for his bromoil work, and is used by courtesy of the Defender Photo Supply Company, which supplies, free (6 cents for postage) a complete description of the process.

The steps are as follows:

From a negative with a full range of tones when viewed by transmitted light reflected from a white surface make a print in the regular way. One of the best papers for this purpose is Velour Black (first choice grade DD; or LER, C, N, or I), fresh stock preferred. Exposure should give good blacks and clear whites with a normal developing period. The developer should be the following formula:

Water 45 oz.
Sodium sulphite (dry) 500 grains
Amidol 75 grains
Potassium bromide 30 grains
Sodium bisulphite (dry) 75 grains

After development rinse in a short-stop bath and fix for at least 15 minutes, with occasional agitation in the following:

Water 60 oz.
Hypo 10 oz.

The print should be thoroughly washed and dried after fixing. Soak the print until limp, and place in the following bleaching solution:

Water 60 oz.
Copper sulphate 330 grains
Sodium chloride (table salt) 1800 grains
Hydrochloric acid (add drop by drop, just sufficient to clear the solution when it is shaken)
Potassium bichromate 40 grains

The image will gradually disappear and the bleaching should be complete, with immersion and constant rocking of the tray continued for a total period equal to twice the time required for the disappearance of the darkest portions of the image. After bleaching the image is faintly visible and of a pale yellow or straw color.

Wash thoroughly to remove all traces of the bleacher color.

Place the print in the following fixing bath for 5 minutes:

Water 60 oz.
Hypo 6 oz.
Sodium sulphite 2 oz.

In this bath the straw-colored image changes to a pale green. This bleaching operation should not be overdone. Wash the print thoroughly and dry. It is even a good plan to resoak and redry the print several times after bleaching.

Suggestions: Always use fresh developer; use plenty of all solutions to ensure thorough chemical action. Process the prints face down with plenty of agitation; dry thoroughly and evenly by suspension of prints so that all surfaces are presented to the air.

Inking.—Print is inked on a piece of plate glass, after having been soaked for a period ranging from 2 to 10 hours at a temperature of 65° or water at 125° for 15 minutes, and then cooled by water. The

ink, placed on a piece of glass, is touched by a bromoil brush, size 1½ in., just enough to contact the tip of the hairs. The brush is then moved to a clean portion of the plate and tapped to remove some of the ink. Little ink is required. In applying the ink to the print hold the brush at a slight angle and perform about 8 to 10 strokes per second making a firm but light contact with the print. The first application of the ink will show a light image; afterwards work up any other portions as completely as desired. Too much ink will give blocked shadows and a patchy coating. The second coat of ink, worked from one starting point into surrounding areas, gives the most even results. A second, clean brush can be used to remove excess ink, by dropping it from slightly above the print and catching it on the rebound. This process is called "hopping."

Paper stumps can be used for clearing small highlights, though a small piece of cotton twisted on the end of a skewer serves the same purpose. Clouds or backgrounds can be worked in with ink, in the same manner as in the paper negative process.

Two inks may be used: one hard and one soft, the soft being used to reduce the heavier consistency of the hard ink. Mr. Partington recommends the use of the hard ink only—Sinclair's "Encre Machine."

Transferring.—For this part of the process pressure must be applied by some method, preferably between rollers or on a flat bed passing under a roller. The best papers to use are those made for water color or etching, to provide for free stripping of the bromoil from the transfer paper. With some papers this may be provided for by soaking the paper in water for about 10 minutes; another method includes the spraying of spirits of turpentine onto the paper, which is then allowed to dry before the sheet is ready for use.

The transfer paper and bromoil print are placed face to face between blotters, and these blotters are then placed between stiff cardboards. This "print pack" is then passed through the press. An examination of a corner of the resulting print may indicate that more pressure is needed, and an additional passage may then be made with increased pressure. Great pressure is not necessary; proper

pressure is important. More impressions may be made from the original bromoil print, by re-inking and transferring. The finished print will require about 10 days to become perfectly dry.

Fresson Process.—This is a process first developed in 1892 in France. It is the same as another called the carbon process, except that the latter involves the transferring of an emulsion to another support, whereas the Fresson print is made by means of a special paper made by the Fresson manufacturers. Fresson paper is coated with a pigment emulsion. It is sold in different colors and different stocks. It has a longer scale than most bromide papers.

The process is performed as follows:

1. The paper is immersed in a 1 per cent solution of potassium bichromate for 4 minutes at 65°. This sensitizes the paper, and only one sheet should be sensitized at a time.

2. Hang up to dry in a darkroom. The paper does not become sensitive until it is entirely dry. The paper should be used within a very few days, before the sensitized pigment hardens.

3. Make a print onto this paper from a negative in a printing frame by exposure to daylight or weak sunlight. The length of the exposure can be determined by using a second negative, of the same subject with same density, and printing through it on a piece of printing-out paper. This has about the same speed as the black or brown Fresson paper. In any case the exposure will probably have to be all day long; if one day does not suffice, the exposure can be continued the next day. The contrast can be controlled as follows: use stronger light and short exposure for soft effect; weak light and long exposure to increase contrast.

4. Development should be done as soon as possible, or the exposed print should be washed to remove the sensitizer. It can then be dried and left undeveloped for some time. Without this washing the pigment would harden and make development difficult. The fastest development is what is called the "sawdust" method. Immerse the exposed print in cold water for 4 minutes. This removes the sensitivity; the rest of the operation can be done in daylight. Next soak the paper for 1 minute in warm water at 86°, drain and lay on a

ferrotype plate. Place this in a slanting position over a tray of sawdust mixed with water into a "soup." Scoop up the sawdust with a pan and pour it evenly over the print. The image should appear in about a minute. Portions needing more development can be worked by using additional sawdust soup on those portions. Development should be performed until the print looks somewhat dry, as the image will darken when dry. If it is difficult to develop, soak again in the warm water bath and resume sawdust developing. An alternate method is by means of a gentle stream of water flowing over the surface, and this process can be used to lighten portions of the print. A small brush applied to the print in a circular motion under the stream of water assists the operation.

5. Hang the picture by one corner to dry. After drying, soak the print for a few seconds and place in a blotter roll to straighten. Spotting can be done with a small moistened brush by taking pigment from a piece of unsensitized Fresson paper of the same color.

Part IV

LABORATORY MANUAL

LABORATORY MANUAL

MIXING CHEMICALS

A *solution* is made by dissolving a solid or liquid in another liquid. The dissolving substance is the *solute*, and the liquid in which it is dissolved is the *solvent*. The extent to which a solute may be dissolved in a solvent is its *solubility*. When a solvent will hold no more of the solute at a definite temperature it is a *saturated solution*. The degree of solubility depends on the nature of the solute, the nature of the solvent, and the temperature. A chemical dissolved in water usually makes a volume of solution greater than that of the water.

Photography is concerned only with the weight or volume of each chemical in a fixed volume of the solution. When mixing, the chemicals should be dissolved in a volume of water less than the formula calls for, and then water added up to the stated volume.

Follow the instructions for all solutions, and add the chemicals in the order given.

NEVER ADD WATER TO AN ACID—it may cause an explosion. Always add acid to water slowly, stirring rapidly.

A *stock solution* is a concentrated solution to which water is added before use.

The percentage strength of a solution indicates the amount of the chemical dissolved in 100 oz. or 100 cc. (cubic centimeters). To make a percentage solution, take the amount of the chemical, dissolve it in a small volume of water, then add water to make 100 oz. (or cc.). A 7 per cent solution of potassium bromide, therefore,

requires 7 oz. of the chemical dissolved and water added to make 100 oz. (or 7 grams dissolved and water added to make 100 cc.) of solution.

Chemicals should be stored in well-corked or stoppered bottles in a cool, dry place.

WEIGHTS AND MEASURES

Chemicals for amateur darkroom work may be weighed on small balance scales, as described in Chapter XVI. Weigh the chemicals on pieces of paper and transfer to the mixing container. Chemicals may be weighed out in the order needed, or all chemicals for a formula may be weighed in advance, before actual dissolving is begun.

Table of Weights.—

	Avoirdupois		Metric
Pounds (lb.)	Ounces (oz.)	Grains (gr.)	Grams (gm.)
1	16	7000	453.6
	1	437.5	28.35
		1	0.065

Table of Liquid Measure.—

		U. S.		Metric
Gallons (gal.)	Quarts (qt.)	Ounces (oz.)	Drams (dr.)	Cubic Centimeters (cc.)
1	4	128	1,024	3,785
	1	32	256	946.3
		1	8	29.6
			1	3.7

In mixing developers take slightly over half the final volume of water (or as directed by formula) in which to dissolve the chemicals. This water should be about 125° F. Add each chemical in the order given and dissolve thoroughly. Dissolving may be done by stirring in a pan or by shaking in a bottle. After all chemicals have been dissolved, add necessary water. It is a good plan to put

a pinch of sulphite into the water in the container before dissolving the chemicals to avoid premature oxidation. "Desiccated" means dried; "anhydrous" means without water.

STANDARD FILM DEVELOPER FORMULAS

Use the formula recommended by the manufacturer.

D-61a

Elon-Hydroquinone Developer, for Tank or Tray

Water (about 125° F.)	16 oz.
Elon	45 gr.
Sodium sulphite, des.	3 oz.
Sodium bisulphite	30 gr.
Hydroquinone	85 gr.
Sodium carbonate, des.	165 gr.
Potassium bromide	24 gr.
Cold water to make	32 oz.

For tray, take one part of developer to one part water; develop about 7 minutes at 65° F.

For tank, take one part developer to three parts water; develop about 14 minutes at 65° F.

DK-50

Kodalk Developer

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	64 oz.	32 oz.	16 oz.
Elon	145 gr.	72 gr.	36 gr.
Sodium sulphite, des.	4 oz.	2 oz.	1 oz.
Hydroquinone	145 gr.	72 gr.	36 gr.
Kodalk	1 oz. 145 gr.	½ oz. 72 gr.	146 gr.
Potassium bromide	29 gr.	15 gr.	7 gr.
Cold water to make	1 gal.	2 qt.	1 qt.

For tray, use full strength; develop about 5 minutes at 65° F.

For tank, take one part developer to one part water; develop about 9 minutes at 65° F.

Greater or less contrast can be obtained by developing for longer or shorter times.

D-76

Elon-Hydroquinone-Borax

For greatest shadow detail on panchromatic film. Used for most roll film in roll film tank.

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Elon	116 gr.	58 gr.	29 gr.
Sodium sulphite, des.	13¼ oz.	6½ oz. 56 gr.	3 oz. 145 gr.
Hydroquinone	½ oz. 72 gr.	145 gr.	72 gr.
Borax, granular	116 gr.	58 gr.	29 gr.
Cold water to make	1 gal.	2 qt.	1 qt.

Use without dilution. For tank, develop about 20 minutes at 65° F.; for tray, decrease time about 20 per cent. Greater or less contrast can be obtained by developing for longer or shorter times.

D-19

Contrast Developer

For use with Super Panchro-Press and Panchro-Press films

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	64 oz.	32 oz.	16 oz.
Elon	128 gr.	64 gr.	32 gr.
Sodium sulphite, des.	12½ oz. 142 gr.	6¼ oz. 72 gr.	3 oz. 92 gr.
Hydroquinone	1 oz. 75 gr.	½ oz. 38 gr.	128 gr.
Sodium carbonate, des.	6 oz. 180 gr.	3 oz. 90 gr.	1½ oz. 45 gr.
Potassium bromide	½ oz. 72 gr.	¼ oz. 36 gr.	74 gr.
Cold water to make	1 gal.	2 qt.	1 qt.

Use without dilution. Develop Super Panchro-Press about 7 minutes in tank or 5 minutes in tray at 65° F. Develop Panchro-Press about 5 minutes in tank or about 4 minutes in tray at 65° F. Greater or less contrast can be obtained by developing longer or shorter times.

D-72
For Press Photography

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	64 oz.	32 oz.	16 oz.
Elon	180 gr.	90 gr.	45 gr.
Sodium sulphite, des.	6 oz.	3 oz.	1½ oz.
Hydroquinone	1½ oz. 46 gr.	½ oz. 132 gr.	175 gr.
Sodium carbonate	9 oz.	4½ oz.	2¼ oz.
Potassium bromide	112 gr.	56 gr.	27 gr.
Cold water to make	1 gal.	2 qt.	1 qt.

For extreme contrast, use without dilution; for average contrast, dilute with equal part of water; for low contrast, dilute with two parts water. Develop about 5 minutes in tank or 4 minutes in tray at 65° F.

D-82
Maximum Energy Developer, for Use with Underexposed Negatives

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Wood alcohol	6 oz.	3 oz.	1½ oz.
Elon	1 oz. 163 gr.	½ oz. 81 gr.	200 gr.
Sodium sulphite, des.	7 oz.	3½ oz.	1¾ oz.
Hydroquinone	1 oz. 163 gr.	½ oz. 81 gr.	200 gr.
Sodium hydroxide (caustic soda)	1 oz. 64 gr.	½ oz. 32 gr.	125 gr.
Potassium bromide	1 oz. 64 gr.	½ oz. 32 gr.	125 gr.
Cold water to make	1 gal.	2 qt.	1 qt.

Develop about 5 minutes in tray at 65° F.

Gives greatest possible shadow density. Does not keep well.

D-7
Elon-Pyro Developer

Stock Solution A

Water (about 125° F.)	16 oz.
Sodium bisulphite	¼ oz.
Elon	¼ oz.
Pyro	1 oz.
Potassium bromide	60 gr.
Water to make	32 oz.

Stock Solution B

Water	32 oz.
Sodium sulphite, des.	5 oz.

Stock Solution C

Water	32 oz.
Sodium carbonate, des.	2½ oz.

For tray, take 2 ounces each of A, B, and C, to 16 oz. of water; develop about 4 minutes at 65° F.

For tank, take 8 ounces each of A, B and C and add water to make 1 gallon; develop about 8 minutes at 65° F. Greater or less contrast can be obtained by developing longer or shorter time.

D-11

High Contrast Developer for Process Film, for Tray Use

Water (about 125° F.)	16 oz.
Elon	15 gr.
Sodium sulphite, des.	2½ oz.
Hydroquinone	130 gr.
Sodium carbonate, des.	365 gr.
Potassium bromide	73 gr.
Water to make	32 oz.

Use full strength; develop 5 minutes at 65° F. If a great contrast is not desired, dilute with equal volume of water.

DK-15

Kodalk Tropical Developer, Nonblistering

Water (about 125° F.)	24 oz.
Elon	82 gr.
Sodium sulphite, des.	3 oz.
Kodalk	¾ oz.
Potassium bromide	27 gr.
Sodium sulphate, des.	1½ oz.
Cold water to make	32 oz.

Use in hot weather. Average developing time at 80° to 90° F. from 5 minutes at 80° F. to 2½ minutes at 90° F.

DK-20
Fine Grain Developer

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Elon	½ oz. 72 gr.	145 gr.	72 gr.
Sodium sulphite, des.	13¼ oz.	6½ oz. 55 gr.	3¼ oz. 28 gr.
Kodalk	116 gr.	58 gr.	29 gr.
Potassium thiocyanate	58 gr.	29 gr.	15 gr.
Potassium bromide	29 gr.	15 gr.	7.5 gr.
Cold water to make	1 gal.	2 qt.	1 qt.

Average time of tank development about 18 minutes at 65° F. or 14 minutes at 70° F. Faster films, such as Super XX, develop about 28 minutes. For tray development, decrease times about 20 per cent.

Agfa 17
Fine Grain Borax Developer for Tank Use

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Metol	88 gr.	44 gr.	22 gr.
Sodium sulphite, anhyd.	10¾ oz.	5¼ oz. 55 gr.	2½ oz. 80 gr.
Hydroquinone	¼ oz. 70 gr.	90 gr.	45 gr.
Borax	¼ oz. 70 gr.	90 gr.	45 gr.
Potassium bromide	30 gr.	15 gr.	7.5 gr.
Water to make	1 gal.	2 qt.	1 qt.

Use full strength. Develop 10 to 15 minutes at 65° F. for fine grain films. For 35 mm. rolls, develop 6 to 12 minutes for best enlarging contrast (6-9 minutes for Finopan; 6-8 minutes for Infra-red; 9-12 minutes for Supreme; 12-15 minutes for Ultra Speed).

Agfa 15
Fine Grain Tray Developer

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Metol	1 oz. 40 gr.	½ oz. 20 gr.	¼ oz. 10 gr.
Sodium sulphite, anhyd.	16¾ oz.	8 oz. 150 gr.	4 oz. 75 gr.
Sodium carbonate, hydrated	1¾ oz. 50 gr.	¾ oz. 90 gr.	¼ oz. 100 gr.
Potassium bromide	88 gr.	44 gr.	22 gr.
Water to make	1 gal.	2 qt.	1 qt.

Use full strength; develop 3 to 5 minutes at 65° F. For greater contrast, develop 6 to 10 minutes.

Agfa 45
Pyro Developer

Stock Solution 1	
Sodium bisulphite	¼ oz. 35 gr.
Pyro	2 oz.
Potassium bromide	16 gr.
Water to make	32 oz.
Stock Solution 2	
Sodium sulphite, anhyd.	3½ oz.
Water to make	32 oz.
Stock Solution 3	
Sodium carbonate, monohydrated	2¾ oz.
Water to make	32 oz.

For tank, take one part each of solutions 1, 2, and 3 and add 11 parts water. Normal developing time, from 9 to 12 minutes at 65° F.

For tray, take one part of each solution and add 7 parts water. Normal developing time from 6 to 9 minutes at 65° F.

Agfa 47
Long-life Formula for Cut Film

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Metol	88 gr.	44 gr.	22 gr.
Sodium sulphite, anhyd.	6 oz.	3 oz.	1½ oz.
Sodium bisulphite	60 gr.	30 gr.	15 gr.
Hydroquinone	¼ oz. 70 gr.	90 gr.	45 gr.
Sodium carbonate, monohydrated	¾ oz. 20 gr.	176 gr.	88 gr.
Potassium bromide	47 gr.	24 gr.	12 gr.
Water to make	1 gal.	2 qt.	1 qt.

Use full strength. For tank, develop 6 to 8 minutes at 65° F. with occasional agitation. For tray, develop 5 to 7 minutes at 65° F.

Agfa 72
Glycin Developer

Stock Solution

Sodium sulphite, anhyd.	4¼ oz.
Potassium carbonate	8½ oz.
Glycin	1½ oz. 80 gr.
Water to make	32 oz.

For tank, take one part stock solution, 15 parts water; develop 20 to 25 minutes at 65° F. For tray, take one part stock solution, 4 parts water; develop 5 to 10 minutes at 65° F.

Agfa 81
Reprolith Developer

Water (about 125° F.)	24 oz.
Hydroquinone	1 oz. 70 gr.
Sodium sulphite, anhyd.	1¾ oz.
Sodium carbonate, monohyd.	2¾ oz.
Citric acid	80 gr.
Potassium bromide	¼ oz. 35 gr.
Water to make	32 oz.

Use full strength; develop about 3 minutes at 65° F.

The above are standard formulas for the development of film. Most regular and all special films come with formulas suggested by the manufacturer for best results. Additional formulas are given in *Eastman Professional Films* and *Agfa Formulas for Photographic Use* (both revised from time to time); see also Eastman's *Elementary Photographic Chemistry*. For securing the best results in darkroom work (and in actual picturemaking as well) I highly recommend the *Photo-Lab-Index* as an indispensable photographic tool.

STANDARD PAPER DEVELOPERS

D-72

This developer, formula given on page 245, is used also for paper; it is called the "Eastman Universal Paper Developer" and can be used for nearly any paper.

For chloride papers, such as Azo and Velox, dilute with 2 parts

water; develop 45 seconds at 70° F. For bromide papers, dilute with 2 or 3 parts water; develop from 45 seconds to 1½ minutes at 70° F.

D-52

Elon-Hydroquinone Developer

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	64 oz.	32 oz.	16 oz.
Elon	88 gr.	44 gr.	22 gr.
Sodium sulphite, des.	3 oz.	1½ oz.	¾ oz.
Hydroquinone	¾ oz. 32 gr.	¼ oz. 70 gr.	90 gr.
Sodium carbonate, des.	2 oz.	1 oz.	½ oz.
Potassium bromide	88 gr.	44 gr.	22 gr.
Water to make	1 gal.	2 qt.	1 qt.

Dilute with equal part water, develop 1½ minutes at 70° F.

Agfa 103

Universal Film and Paper Developer

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Metol	¼ oz. 95 gr.	100 gr.	50 gr.
Sodium sulphite, anhyd.	7½ oz.	3½ oz. 100 gr.	1¾ oz. 50 gr.
Hydroquinone	1½ oz.	¾ oz.	¼ oz. 55 gr.
Sodium carbonate, monohyd.	10½ oz.	5 oz. 70 gr.	2½ oz. 35 gr.
Potassium bromide	72 gr.	36 gr.	18 gr.
Water to make	1 gal.	2 qt.	1 qt.

For bromide paper, dilute with 2 parts water; develop 1 to 1½ minutes at 70° F.

Agfa 106

Warm-tone Developer for Chloride Paper

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Metol	42 gr.	21 gr.	10 gr.
Sodium sulphite, anhyd.	1½ oz. 20 gr.	¾ oz. 10 gr.	¼ oz. 60 gr.
Hydroquinone	¼ oz. 95 gr.	100 gr.	50 gr.
Sodium carbonate, monoh.	1¼ oz. 30 gr.	½ oz. 70 gr.	¼ oz. 35 gr.
Potassium bromide	¼ oz. 30 gr.	70 gr.	35 gr.
Water to make	1 gal.	2 qt.	1 qt.

Develop about 1 minute at 70° F.

Agfa 125
Bromide Paper Developer

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Metol	¼ oz. 70 gr.	90 gr.	45 gr.
Sodium sulphite, anhyd.	6 oz.	3 oz.	1½ oz.
Hydroquinone	1½ oz. 20 gr.	½ oz. 120 gr.	¼ oz. 60 gr.
Sodium carbonate, monoh.	9 oz.	4½ oz.	2¼ oz.
Potassium bromide	¼ oz. 10 gr.	60 gr.	30 gr.
Water to make	1 gal.	2 qt.	1 qt.

Dilute with 2 parts water; develop 2 to 6 minutes at 70° F.

Agfa 135
Warm-Tone Paper Developer

	1 gal.	2 qt.	1 qt.
Water (about 125° F.)	96 oz.	48 oz.	24 oz.
Metol	96 gr.	48 gr.	24 gr.
Sodium sulphite, anhyd.	3¼ oz.	1½ oz. 40 gr.	¾ oz. 20 gr.
Hydroquinone	¾ oz. 60 gr.	¼ oz. 82 gr.	96 gr.
Sodium carbonate, monoh.	3¼ oz.	1½ oz. 40 gr.	¾ oz. 20 gr.
Potassium bromide	¼ oz. 50 gr.	80 gr.	40 gr.
Water to make	1 gal.	2 qt.	1 qt.

Dilute with equal part of water; develop about 1½ to 2 minutes at 70° F.

Agfa 113
Amidol Developer

Amidol	96 gr.
Sodium sulphite	1¼ oz. 90 gr.
Potassium bromide	8 gr.
Water to make	32 oz.

Use full strength; develop 1 to 2 minutes at 70° F.

Most papers are accompanied by formulas suggested by the manufacturers. See also *Agfa Formulas for Photographic Use, Eastman Photographic Papers,* Universal and other almanacs, and *Photo-Lab-Index.*

RINSING AND SHORT-STOP FORMULAS

A short-stop bath should be used between developing and fixing for prints, and many photographers believe it should be used for film as well. It prevents stains, helps to toughen the emulsion, and keeps glossy prints from sticking to ferrotype tins.

SB-1

Acid Short-stop Bath

Acetic acid 28%	1½ oz.
Water	32 oz.

To make 28 per cent acetic acid from glacial (99 per cent), dilute three parts glacial acetic acid with 8 parts water.

For prints, rinse at least 5 seconds, moving and separating the prints to ensure thorough access of the solution. Use fresh bath for each batch of prints.

SB-3

Hardening Bath for Negatives

Water	32 oz.
Potassium chrome alum	1 oz.

Rinse films about 5 seconds in water, then place for about 3 minutes in this hardening bath. Agitate for a few seconds.

SB-4

Tropical Hardening Bath

(Used as rinse in connection with tropical developer DK-15)

Water	32 oz.
Potassium chrome alum	1 oz.
Sodium sulphate, des.	2 oz.

Rinse films not more than 1 second in water, then 3 minutes in this bath.

FIXING SOLUTIONS

The fixing bath must be acid, and the acidity can be maintained more easily by use of a short-stop bath before fixing. The fixing bath

should be discarded when it becomes milky or foamy, though best results are obtained by using a fresh bath for each batch of prints or films.

F-5
Acid Hardening Fixing Bath for Films

Water (about 125° F.)	80 oz.
Hypo	2 lb.
Sodium sulphite, des.	2 oz.
Acetic acid 28%	6 fl. oz.
Boric acid *crystals*	1 oz.
Potassium alum	2 oz.
Cold water to make	1 gal.

Fix for 10 minutes, or twice clearing time. When time in fixing bath exceeds 20 minutes, discard solution. Solution will fix 80 to 100 films 8 x 10, or equivalent.

F-5a
Stock Hardener

Water (about 125° F.)	80 oz.
Sodium sulphite, des.	10 oz.
Acetic acid 28%	30 fl. oz.
Boric acid *crystals*	5 oz.
Potassium alum	10 oz.
Cold water to make	1 gal.

To make a fixing bath, take 1 part cool stock hardener to 4 parts cool hypo solution, made by dissolving 2½ lb. of hypo per gallon of water while stirring hypo rapidly.

F-1
For Papers

Water (about 125° F.)	64 oz.
Hypo	16 oz.

When thoroughly dissolved, add following hardening solution:

Water (about 125° F.)	5 oz.
Sodium sulphite, des.	1 oz.
Acetic acid (28%)	3 fl. oz.
Potassium alum	1 oz.

Cool hardener solution and add to cool hypo solution while stirring rapidly. Will fix approximately 60 prints 8 x 10, or equivalent, if acid rinse is used between developing and fixing.

F-1a

Stock Hardener

Water (about 125° F.)	56 oz.
Sodium sulphite, des.	8 oz.
Acetic acid (28%)	24 fl. oz.
Potassium alum	8 oz.
Cold water to make	1 gal.

To make a fixing bath take 1 part cool stock hardener to 4 parts cool hypo solution, made by dissolving 2 lb. of hypo to gallon of water.

Formulas F-1 and F-1a differ from F-5 and F-5a chiefly in omission of boric acid. If you use one fixing solution for both films and prints, use F-1 and F-1a.

Agfa 201

Acid Hardening Bath for Films and Papers

Solution 1	
Hot water (125° F.)	½ gal.
Hypo	2 lb.
Solution 2	
Hot water (125° F.)	20 oz.
Sodium sulphite, anhyd.	2 oz.
Acetic acid 28%	6 fl. oz.
Potassium alum	2 oz.

Add solution 2 to solution 1 and add water to make 1 gallon, while stirring.

HT-1a

Hypo Test Solution

Distilled water	6 oz.
Potassium permanganate	4 gr.
Sodium hydroxide (caustic soda)	8 gr.
Distilled water to make	8 oz.

Take 4 oz. of distilled water in a clean glass and add ¼ gram

(1 cc.) of above solution. Pour ½ oz. of this diluted solution into a clean 1-oz. graduate. Allow water from 6 prints or films from the wash water to drip into this solution for 30 seconds. If hypo is still present, the violet color will turn orange in about 30 seconds. A similar test should be made with the tap water by adding a small amount to ½ oz. of a diluted test solution. If the sample of test solution remains violet, there is no organic matter in the tap water. If the color is changed slightly by the tap water the presence of hypo in the prints will be shown by the relative color change of the two samples. For example, if the tap water sample turned pink and the wash water sample became yellow, it would indicate the presence of hypo, while if both samples remained the same shade it would indicate the absence of hypo.

There is also an electrical method of testing for the presence of hypo.

INTENSIFICATION FORMULAS

The intensification process is used for underdeveloped or underexposed films. Films should first be hardened by treatment, for 3 minutes, in the following:

SH-1

Formalin Hardener

Formalin (37% formaldehyde sol.)	2½ dr.
Sodium carbonate, des.	70 gr.
Water to make	32 oz.

The films should then be immersed 5 minutes in a fresh acid fixing bath and washed thoroughly.

In-1

Mercury Intensifier

Potassium bromide	¾ oz.
Mercuric chloride (A DEADLY POISON)	¾ oz.
Water to make	32 oz.

Bleach negative in this solution until it is white, then wash

thoroughly, then blacken in (1) a 10 per cent sodium sulphite solution; or (2) formula D-61a, diluted 1 to 1; or (3) 10 per cent ammonia (1 part 28 per cent ammonia to 9 parts water). These give progressively greater density in the order given.

In-4
Chromium Intensifier

Stock Solution	
Water	32 oz.
Potassium bichromate	3 oz.
Hydrochloric acid, C. P.	2 fl. oz.

Take 1 part stock solution to 10 parts water. Bleach negative thoroughly, wash 5 minutes and redevelop in artificial light or daylight (not direct sunlight) in a nonstaining developer such as D-61a, diluted 1 to 3. Fixing is unnecessary if redevelopment is thorough. If further treatment is necessary, repeat the process.

In-5
Silver Intensifier

This is the only known intensifier which gives an image of neutral color. Process may be followed visually.

Stock Solution 1	
Silver nitrate, *crystals*	2 oz.
Water, distilled, to make	32 oz.
(keep in brown bottle)	
Stock Solution 2	
Sodium sulphite, des.	2 oz.
Water to make	32 oz.
Stock Solution 3	
Hypo	3½ oz.
Water to make	32 oz.
Stock Solution 4	
Sodium sulphite, des.	½ oz.
Elon	350 gr.
Water to make	96 oz.

Add 1 part solution 2 slowly to 1 part solution 1, shaking or stir-

ring. Dissolve the white precipitate by adding 1 part solution 3, and allow resulting solution to stand a few minutes until clear. Add, with stirring, 3 parts solution 4, and treat the film immediately. Degree of intensification depends on time of treatment, which should not exceed 25 minutes. After treatment, immerse and agitate for 2 minutes in a 30 per cent hypo solution and wash thoroughly.

REDUCTION FORMULAS

R-2

Stock Solution A	
Water	32 oz.
Potassium permanganate	1¾ oz.
Stock Solution B	
Water	32 oz.
Sulphuric acid, C. P.	1 fl. oz.

(Acid must be added to the water slowly and with stirring. Never add water to acid.)

Take 1 dr. of A, 2 dr. of B, and 8 oz. of water. When negative has been reduced sufficiently place in fresh acid fixing bath (Formula F-5) for a few minutes and wash thoroughly.

R-4a

Farmer's Reducer

For overexposed negatives.

Stock Solution A	
Water	16 oz.
Potassium ferricyanide	1¼ oz.
Stock Solution B	
Water	64 oz.
Hypo	16 oz.

May be used either as two-solution or one-solution reducer.

As one-solution reducer, take 1 oz. stock solution A, 4 oz. stock solution B, water 32 oz. Watch action closely, and when negative has been reduced sufficiently wash thoroughly. The two solutions

do not keep long in combination. The one-solution reducer corrects for overexposure.

As two-solution reducer, to correct for overdevelopment, treat negative in ferricyanide solution first and afterwards in the hypo solution.

Another two-solution, Farmer's reducer (R-4b), uses only ¼ oz. ferricyanide to 32 oz. water, and only 6¾ oz. hypo to 32 oz. water.

TONING FORMULAS

T-7a
Sepia Toner

Stock Bleaching Solution	
Potassium ferricyanide	2½ oz.
Potassium bromide	2½ oz.
Potassium oxalate	6½ oz.
Acetic acid (28%)	1¼ fl. oz.
Water	64 oz.
Stock Redeveloping Solution	
Sodium sulphide (not sulphite)	1½ oz.
Water	16 oz.

Print to be toned must be fixed and washed thoroughly. Place in bleaching bath made from 1 part stock bleaching solution and 1 part water and allow to remain until only faint traces of the image remain, or about 1 minute. Then rinse thoroughly in clean water and place in redeveloping bath made of 1 part stock redeveloping solution and 8 parts water, until original detail returns, which will take about 30 seconds. Rinse in clean water, immerse for 5 minutes in bath made of 1 oz. F-1a hardener, 8 oz. water, then wash one-half hour.

T-1a
Hypo-Alum Sepia Toner

Cold water	90 oz.
Hypo	16 oz.

Dissolve thoroughly and add following solution:

Hot water (about 125° F.)	20 oz.
Potassium alum	4 oz.

Then add following solution, including precipitate, slowly while stirring rapidly:

Cold water	2 oz.
Silver nitrate, *crystals*	60 gr.
Sodium chloride (table salt)	60 gr.

After combining solutions add water to make 1 gallon. Bath must be heated to 120° F. but no higher. Prints will tone in from 12 to 15 minutes.

T-21
Nelson's Gold Toner

Solution 1	
Water (about 125° F.)	1 gal.
Hypo	2 lb.
Ammonium persulphate	4 oz.

Stir bath vigorously while adding the ammonium persulphate. If bath does not turn milky, heat until it does.

When above solution is cool, slowly add following solution, including precipitate, while stirring rapidly:

Cold water	2 oz.
Silver nitrate, *crystals*	75 gr.
Sodium chloride (table salt)	75 gr.

(Silver nitrate must be completely dissolved before salt is added.)

Stock Solution 2	
Water	8 oz.
Gold chloride	15 gr.

Add 4 oz. solution 2 slowly to solution 1, stirring rapidly. Bath should not be used until it has become cold and sediment formed. Then pour off the clear liquid for use into a tray in a water bath heated to 110° F. Soak dry prints thoroughly in water before toning.

Keep a black-and-white print at hand during toning for comparison. Keep prints separated to ensure even toning. When desired tone is obtained, rinse prints in cold water, place in fixing bath for 5 minutes, wash for an hour in running water.

The bath may be revived by addition of the gold chloride solution, for example, by adding 1 dr. after 50 prints 8 x 10, or equivalent, have been toned in original solution. Time of toning depends upon type of paper used, and varies from 5 to 20 minutes.

MISCELLANEOUS FORMULAS

S-6
Stain Remover

For removing developer or oxidation stain. Use after treating negatives in Formalin Hardener (SH-1).

Stock Solution A	
Water	32 oz.
Potassium permanganate	75 gr.
Stock Solution B	
Water	32 oz.
Sodium chloride (table salt)	2½ oz.
Sulphuric acid C. P.	½ fl. oz.

Use equal parts A and B, mixing solutions when ready for use. Bleaching should be complete in 3 or 4 minutes. Brown stain formed in the bleaching bath may be removed by immersing film in 1 per cent sodium bisulphite solution. Rinse film well and develop in strong light (except direct sunlight) with any nonstaining developer, such as D-61a.

TC-1
Tray Cleaner

Water	32 oz.
Potassium bichromate	3 oz.
Sulphuric acid, C. P.	3 fl. oz.

Add sulphuric acid slowly to bichromate solution with stirring. Pour small amount into tray to be cleaned and rinse around so that

solution comes in contact with all parts of the tray. Pour out the solution and rinse tray 6 or 8 times with water.

Desensitizer—Pinakryptol Green

Pinakryptol green	15 gr.
Water to make	16 oz.

Dilute 1 part solution with 10 parts water. Immerse films in total darkness for 2 minutes at 65° F. Development may then be done under bright red light.

Pinakryptol yellow may be used instead of the green, but permits panchromatic plates and films to be handled only under green light.

Direct Positive Processing

The processing of direct positive paper requires 6 operations in the reversal of the image, as follows (series 2 Wratten safelight can be used for first steps):

1. Develop from 45 seconds to 1 minute in direct positive developer D-88:

Water (about 125° F.)	96 oz.
Sodium sulphite, des.	6½ oz.
Hydroquinone	3¼ oz.
Boric acid, *crystals*	¾ oz.
Potassium bromide	150 gr.
Sodium hydroxide (caustic soda)	3¼ oz.
Water to make	1 gal.

Caustic soda should be dissolved in a small volume of water. Use developer full strength at 70° F. Wash print 15 seconds in running water.

2. Bleach about 30 seconds, in following solution:

Water	1 gal.
Potassium bichromate	1¼ oz.
Sulphuric acid, C. P.	1½ fl. oz.

Use full strength at 65° to 70° F., wash print 15 seconds in running water.

3. Clear print about 30 seconds in:

Sodium sulphite, des.	12 oz.
Water	1 gal.

Use full strength at 65° to 70° F. Wash print for 15 seconds in running water. White light may be turned on when print is placed in this clearing bath.

4. Reexposure. This is taken care of if white light is turned on when prints are placed in clearing bath. If sepia tone is desired, it is not necessary to reexpose.

5. Redevelop in D-88 for 30 seconds. For sepia tone, redevelop in a solution containing 300 gr. sodium sulphide (not sulphite) in 32 oz. of water, at 65° to 70° F.

6. Fixing. This step is not essential but gives print slightly increased brilliance. If fixing is done, use formula F-5, fix for 30 seconds. Fixed prints should be washed in running water for 10 minutes; prints not fixed may be washed for 5 minutes. The prints dry rapidly, or drying may be forced by means of electric hair driers.

Dufaycolor Development

Dufaycolor film is developed by reversal, in the following steps:

1. Develop 5 minutes at 65° F. in following solution:

Metol	16 gr.
Hydroquinone	128 gr.
Sodium sulphite, anhyd.	1¾ oz.
Sodium carbonate, dry	1¼ oz.
Potassium bromide	80 gr.
Potassium thiocyanate	144 gr.
Water	35 oz.

Wash film 1 minute in running water or immerse for ½ minute in short-stop SB-1.

2. Bleach until image is clearly visible, about 4 minutes, in following:

Potassium bichromate	80 gr.
Sulphuric acid, C. P.	10 cc.
Water	35 oz.

When film has been in this bath for 2 minutes, white light may be turned on. Wash film for 2 minutes.

3. Clear for 2 minutes in:

Sodium bisulphite	400 gr.
Water	35 oz.

Wash film for two minutes.

4. Reexpose for about 1 minute at a distance of 12 inches from a 100-watt light bulb. It is better to overexpose than underexpose.

5. Redevelop for 4 minutes at 65° F. in first developer. However, if first developer is used for this redevelopment it cannot again be used for first development of other films. Or use:

Metol	32 gr.
Hydroquinone	144 gr.
Sodium sulphite, dry	2¾ oz.
Sodium carbonate, dry	1¾ oz.
Water	35 oz.

6. Fix in standard fixing solutions, or 5 minutes in:

Hypo	14 oz.
Potassium metabisulphite	½ oz.
Water	35 oz.

Dissolve separately and add:

Chrome alum	160 gr.
Water	35 oz.

7. Wash for 15 minutes, wipe with viscose sponge and dry.

See also *The Dufaycolor Manual.*

Metol Poisoning

This is a skin irritation to which a few persons are susceptible, especially when developer is permitted to remain on the hands. Use hand lotions before doing developing work, or keep the hands thoroughly washed or rinsed, to prevent the "poisoning." Rubber gloves will eliminate the possibility, and washing the hands with soap and warm water after developing work will aid in preventing irritation. Here is a formula that has assisted many:

Ichthyol	1 dr.
Boric acid	1 dr.
Zinc oxide	½ dr.
Petrolatum	1 dr.

Wash the hands and apply. Protect by bandage.

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